Electrical Review

With Which Is Consolidated WESTERN ELECTRICIAN and ELECTROCRAFT.

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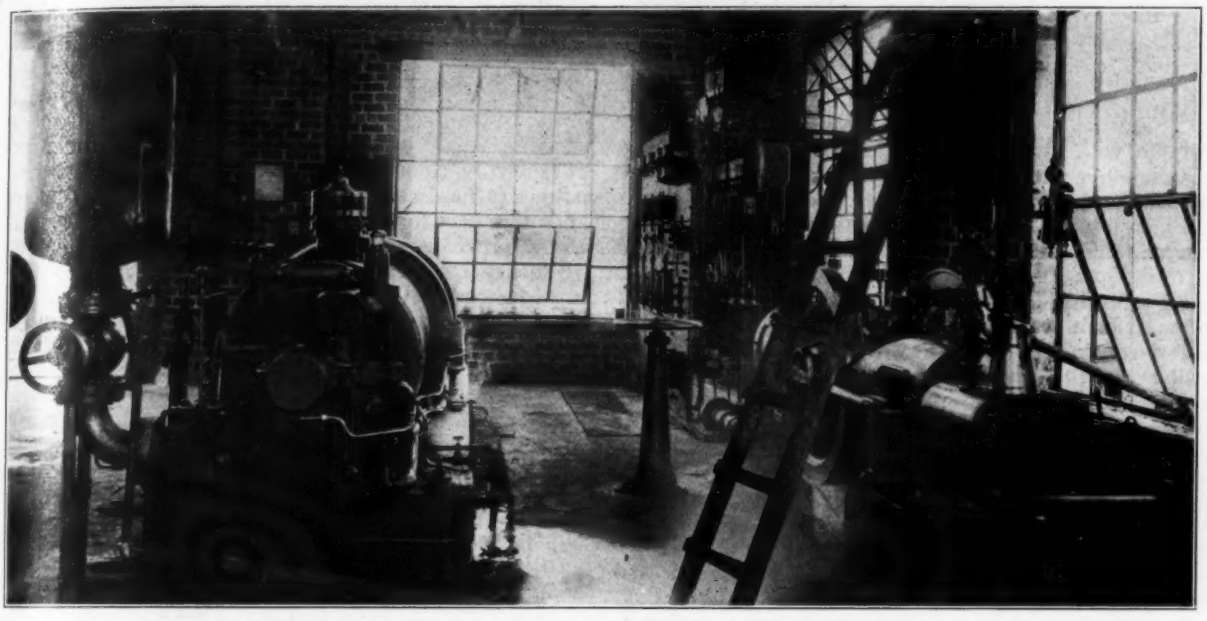


View of Steam-Turbine End of Main Unit in Murphysboro Electric Plant with Switchboard and Air Pump at Right.

Unique Features of the New Power Plant at Murphysboro, Illinois

Second Half of Article Describing Novel Reconstruction of Combination Electric, Water and Gas Plant in a Small City

A BRIEF summary of the conditions leading to the complete reconstruction of the combination electric, water and gas plants at Murphysboro was given in the last issue, some of the unique features being alluded to. The following article gives a somewhat detailed description of the new plant. It must be remembered that it is situated close to the Big Muddy River, whose level varies about 34 feet during the year.

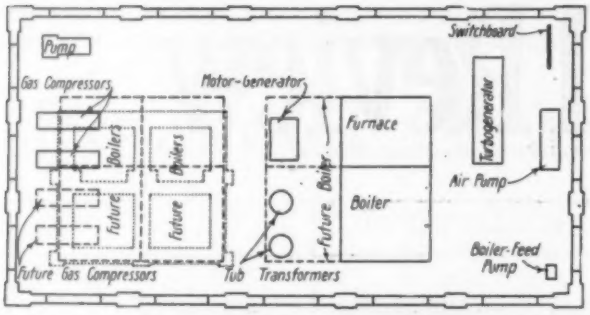
DETAILS OF NEW PLANT.

Before taking up a more detailed description of the plant, it should be noted that the accompanying illustrations were taken before the construction work was entirely completed; in other words, they are progress pictures, and may not appear so tidy as when everything is in shipshape order.

Coal is delivered to the plant from a mine just west of the city by means of the street railway that passes directly in front of the plant. It is dumped into a hopper below the track and fed into an inclined motor-driven coal conveyor furnished by the Stephens-Adamson Manufacturing Company, of Aurora. This discharges into a hopper in the upper corner of the boiler room, from which it is spouted into the hopper over the stoker. After the second, third and fourth boilers have been added a coal conveyor will be erected along the length of the boiler room, feeding from the inclined conveyor into the hoppers for the four boilers.

From the illustration showing the boiler front it can be seen that the furnace extends well in front of the boiler. This equipment is the "Model" automatic smokeless furnace and stoker of 7 by 7 feet size, with V-shaped grate, manufactured by the Model Stoker Company, Dayton, Ohio. The stoker is driven by a small steam engine. Ashes drop from the grate bottom directly into the open space between the boiler and building foundations.

The single boiler now installed is of the Erie City Iron Works vertical water-tube type and is rated at 306 horsepower. It is capable of working at 200 pounds pressure and of being forced to about 450 horsepower capacity. A Foster superheater, furnished by the Power Specialty Company, is provided in con-



Rough Floor Plan of Present and Proposed Future Layout of Equipment in What is Now Combined Turbine and Boiler Room.

nection with the boiler. An additional boiler will be placed alongside the present unit in the near future to complete the first battery. In the smoke uptake is a Bailey induced-draft blower driven by a Troy steam engine. The steel stack is 68 inches in diameter and extends 25 feet above the boiler-room roof.

The boiler feed water is handled by the hot-well pump, which forces the condensate through a Stillwell-Bierce open feed-water heater that is mounted on a gallery in the southeast corner of the room. It is heated by exhaust steam from the two condenser pumps, the boiler feed pump, the stoker and draft engines and two steam-driven gas compressors, now located in the west end of the room. An American Steam Pump Company boiler feed pump located on the main floor, directly below the heater, supplies the boiler.

The main unit is an Allis-Chalmers horizontal high-pressure turbine, directly connected to a 625-kilowatt, three-phase, 60-cycle, 2300-volt generator. This unit operates at 3600 revolutions per minute and has at the north end a direct-connected exciter of 9 kilowatts and 125 volts rating. The turbine is operating with a vacuum of about 28½ inches.

The exhaust from the turbine passes directly into an Allis-Chalmers surface condenser of 1500 square feet cooling surface. The condenser is set into a section of the turbine foundation. It has connected with it only two auxiliary pumps. The circulating pump is dispensed with, because the pump connected with the water supply system and which draws the water from the river passes it through the condenser on its way to the first of the water-treating basins. Both the hot-well and the vacuum pumps are steam-driven, and of Allis-Chalmers make, the latter being 15 by 10 inches and mounted on the main floor.

In the corner of the room and close to the generator is a five-panel switchboard. This is of General Electric manufacture and standard type. The generator panel has the usual indicating voltmeter, ammeter and polyphase wattmeter, also field current ammeter, field rheostat and switch, the main generator oil switch and a 200-ampere watt-hour meter. A synchronizing indicator is mounted at the extreme right end of the board. There is a second panel for connecting the new and old stations in parallel. There are also three feeder panels. All of the switches are protected by overload relays.

At the present time the feeder circuits are still connected to the switchboard in the old power house, although the two two-phase generating units in the latter are shut down. The old and new boards are connected together through a set of Scott phasing transformers, placed between the new and old buildings. The old plant and distribution system were laid out on the two-phase plan and it has not been possible to change all of the distribution system to three phase. This work is now under way and will not necessitate very much changeover, however, because the load is now almost entirely lighting.

As stated above, the old plant is being held for reserve until the new work is entirely completed. It is probable that ultimately it will be entirely dismantled, but this will probably be only after a new turbine room has been erected with a complete switchboard, including feeder panels for the various distributing circuits, street-lighting circuits and street-railway circuit.

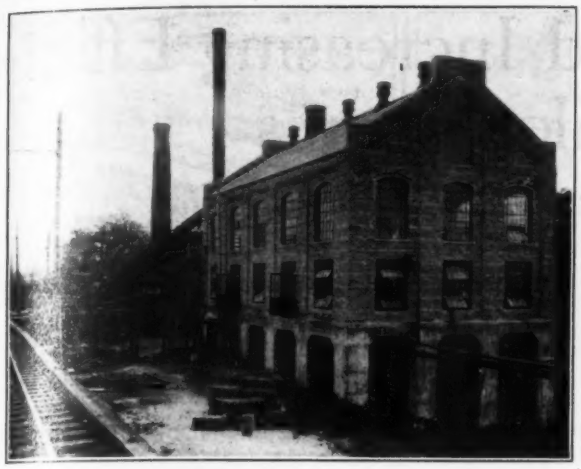
There is in immediate prospect considerable additional load. The street-railway line has been extended as an interurban line to Carbondale, Ill., about 10 miles away, and this interurban was placed in operation September 1. This line is operated by the Murphysboro & Southern Illinois Electric Railway Company. It hauls considerable coal from nearby mines and it is probable that other freight, as well as local and interurban passengers, will be taken care of. All of the energy supply of this electric railway is furnished from the Murphysboro plant.

A number of coal mines in the neighborhood are planning to secure power from the Murphysboro company; also several local factories. Directly west of the electric plant, on the opposite side of the river, is a new steel foundry, being erected by the Harrison Steel Castings Company, which has already contracted for the supply of 325 kilowatts of energy. A new silica brick plant is also being erected. All these developments indicate that the present generating unit will be well loaded up before many months, and the probability is that the additions to the plant will be made in a not distant future.

Water and Gas Plants.

The new water works, which was completed in January, 1916, consists of two large concrete basins, each about 60 feet in diameter, and a brick building in which are located the sand filter beds and the chemical and operating rooms. The pump equipment of the water supply system consists at present of two Laidlaw-Dunn-Gordon steam-driven pumps about 10 years old, and one Dean steam pump about 17 years old. Each of these is in a separate brick well at a level very close to the low-water level of the river. These pumps, on account of their age and poor condition, are operating at very poor economy, especially during the winter, when considerable condensation of

Switchboard and Generator End of Main Unit.



View of New Electric Plant With Old Plant in Left Background.

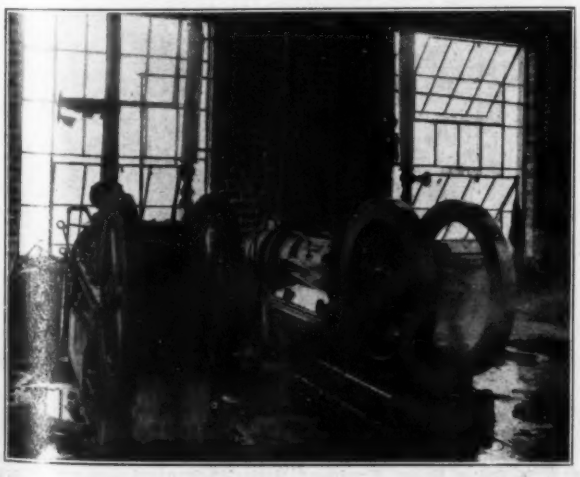
View of Old Electric Plant and Inclined Coal Conveyor to New Plant.

steam occurs in the exposed piping. Work is now under way to replace these steam pumps with two electrically driven pumps supplied by the American Well Works, Aurora, Ill. One of these will be a vertical centrifugal pump, with a capacity of 2200 gallons per minute, against a head of 57 feet. It is to be driven by a 35-horsepower, three-phase General Electric induction motor. This pump is the one that will be used for drawing the water from the river, passing it through the condenser and then to the first of the treating basins. A horizontal eight-inch multistage pump will also be installed for pumping the water from the clear well into the city water service system. It will be driven by a 100-horsepower, three-phase General Electric induction motor and will be capable of working against a 200-foot head.

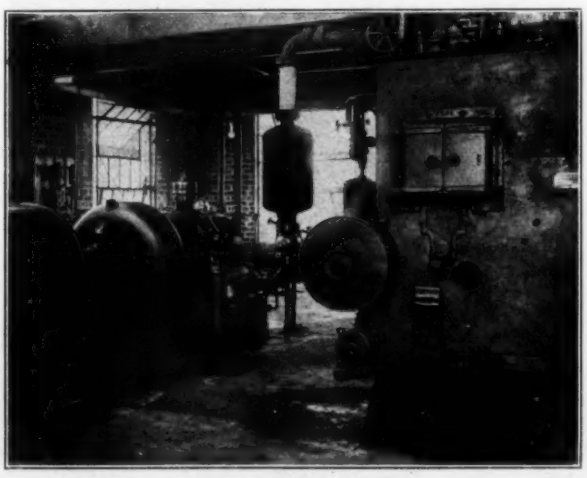
The water treating plant is located on the opposite side of the electric railway, north of the electric plant. The water is received in a large coagulating basin, where it is treated with alum, which causes the water to clarify and the mud to settle. This basin is sectionalized by means of concrete interior partitions, so that the water passes slowly through a devious path and then flows by gravity through a set of sand filters in the basement of the brick building adjoining. From the filters it passes into the clear well, which is another concrete basin in front of this building. This well serves also as a reservoir. The water is pumped from this clear well into the mains. At the present time about 1,250,000 gallons per day are pumped by this plant. A pressure tank is located on a little hill about a quarter of a mile west of the station. This tank is 50 feet high and mounted on top of a 100-foot steel tower. All water sold is metered.

The gas works that were completed and placed in operation last March are located a short distance west of the plant. Gas is manufactured by the water gas process and is distributed locally at low pressure. A gas holder with a capacity of 100,000 cubic feet adjoins the gas plant. The company also distributes gas at high pressure to a large number of towns in the vicinity, including Carbondale, Carterville, Marion, Johnson City, West Frankfort, Benton, Christopher, Du Quoin and Herrin. This high-pressure system is operated by two Rand Drill Company steam-driven gas compressors, located at the west end of the boiler room. The new gas works are operated at a very much better economy than the old plant and comparatively few men are required in this portion of the plant.

It is expected that when the electric pumps are placed in operation for the water works, a very material increase in economy will result. Taking the water and electric plants together, it is believed that a saving of over 33 per cent in coal will be effected over the consumption of the old plant.



Two Steam-Driven Gas Compressors.



Main Turbogenerator at Left. Furnace Front With Stoker Drive at Right.

Reducing Labor and Increasing Efficiency in Boiler Rooms

War-Time Conditions Have Emphasized the Economies of Coal and Ash-Handling Equipment For the Small and Moderate Sized Plant As Well As the Large

By J. H. EDSALL

Engineer, Link-Belt Company, Philadelphia.

IN large central power stations the reduction of labor costs and the increasing of the efficiency of operation are given careful consideration, but in the majority of the smaller plants these points are not worked out as carefully as they should be. There has, however, been much improvement in late years and with the present high prices of coal and labor, and a more general appreciation of the money-saving possibilities, the small and moderate sized boiler rooms are beginning to receive the attention that they deserve.

It has been amply demonstrated that the intelligent operation of boilers is not likely to be obtained by leaving the boiler room entirely in the hands of men who have worked up from the ranks, but that it requires the direction of trained and experienced technical men, who are able to determine what results are being achieved in regular operation, and who know how to make improvements in methods of operation with the equipment at hand or, if it seems advisable, to make such improvements in equipment as will give better results.

While in many of the smaller boiler rooms the furnaces are still fired by hand, mechanical stokers are coming into use very rapidly and since they tend to reduce labor and increase efficiency, they are of especial interest at the present time. As they are primarily an automatic feeding device, it is obviously illogical to use them to feed the coal to the furnaces and still use hand methods to get the coal to the magazines.

The approved method is to take the coal up to an overhead bin and let it feed down by gravity either direct to the magazines or to an intermediate weighing hopper or traveling larry which spouts the coal to the magazines.

In addition to the mechanical handling of the coal it is customary to provide a crusher which breaks up the large lumps instead of having them broken by slow and more laborious hand methods.

With an equipment of this kind to deliver properly

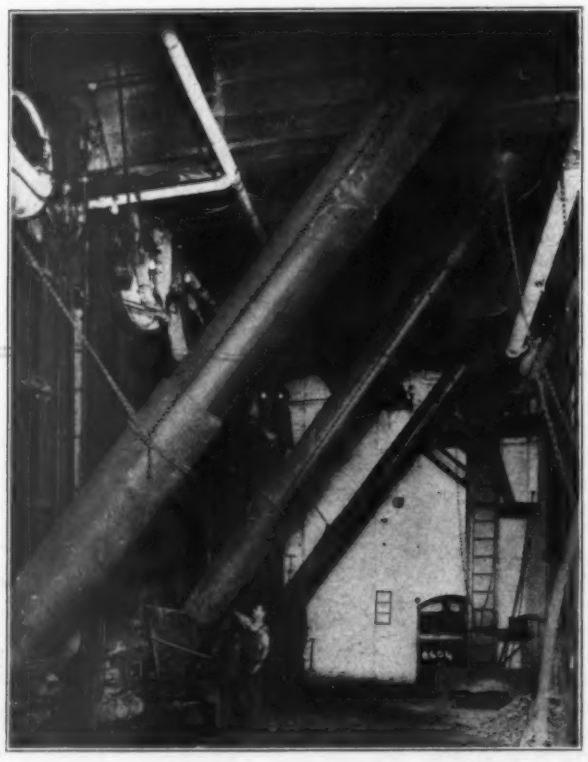


Fig. 1—Boiler Room Equipped with Mechanical Stokers, which are Fed by Means of Spouts from an Overhead Bin. Note Only One Man in Attendance.

Fig. 2—Boiler Room Equipped with Mechanical Stokers Where Lumps are Broken by Hand and Coal Shoveled to Stoker Magazine. Three Men Required.

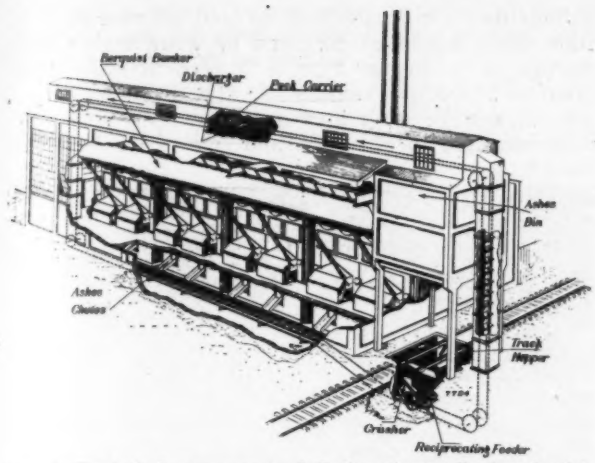


Fig. 3—Typical Arrangement of Boiler House Equipped with Peck Riveted Bucket Carrier and Overhead Coal and Ashes Bin.

sized coal to the stokers, the stoker operator has the drudgery and hard labor removed from his job, so that it makes it attractive to a better class of man, and he can give his whole attention to operating the stokers. This makes it possible for one man to handle a greater number of boilers and to obtain higher efficiencies, thereby making a considerable saving in fuel.

A well known combustion engineer states:

"This question of fuel economy is an important one, and it has been proved that with poor firing, with this type of stoker, the boiler efficiency may drop below 60 per cent, but with good firing it is possible to operate at 70 per cent or even better; this difference in efficiency being equivalent to a saving of 15 per cent in the amount of fuel used. It would certainly be safe to count on at least 5 per cent lower fuel consumption in a mechanically operated plant. On a basis of 36,000 tons of coal per year, this would mean 1,800 tons of coal saved, which, figured at a cost of $3.00 per ton, would be a saving of $5,400.00 per year."

Saving Effected by Mechanical Equipment.

The following table of comparison of costs refers to a boiler room arranged for eight 400-horsepower boilers set in batteries of two each. This makes a total of 3200 rated horsepower. While probably not more than six boilers would be in operation at one time, it is figured that the boilers would be run at 125 per cent of rating. This would mean that the actual horsepower would be about 3,000, and the amount of coal used would probably run in the neighborhood of 100 tons per day. The stokers are taken as the "Murphy" type, and it is assumed that there would be one stoker operator for each boiler where the coal is shoveled to the stokers and one operator for each two boilers where the coal is delivered by gravity. The wages of the stoker operators are assumed at $25 per week, and the wages for ordinary labor for handling coal and ashes at $14 per week.

The first equipment is assumed to have a trestle close alongside the boiler room, so that the coal can be stored on the ground underneath, and then wheeled into the boiler room, the lumps broken by hand and the coal shoveled to the stokers. In this case there is an allowance made of two men for wheeling the coal and ashes on each shift. With the second equipment the boiler room is supposed to be equipped with coal and ash-handling machinery and a 400-ton overhead bin, i. e., about four days' supply, and with this equipment there is an allowance of one day man for operating and taking care of the conveyor, and feeding ashes to it, besides helping with the coal handling,

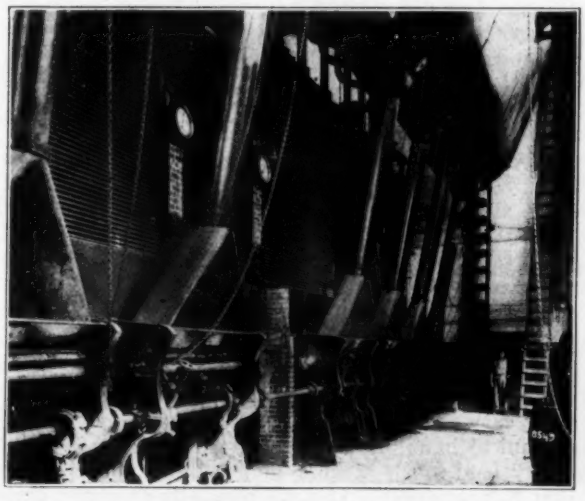


Fig. 5—New Boiler Room at the Principal Plant of the Thos. Wolstenholme & Sons Co., Philadelphia, Pa., Equipped with Mechanical Stokers, Overhead Coal and Ashes Bin and Pivoted Bucket Carrier for Handling Coal and Ashes.

and one night man at $15 per week for handling ashes.

In unloading the coal from the cars, other men would be employed for helping get coal out of the cars, and the cost of doing this work is taken at three cents per ton in either case, including conveying coal to bin with machinery. The cost of power for operating the machinery would probably be about offset by the additional labor in unloading the cars on the trestle, when the coal had to be trimmed out from underneath the trestle by hand so as to give more room for unloading the cars.

BOILER ROOM EQUIPPED WITH TRESTLE.

Investment for trestle, say $5,000.00; coal wheeled to boiler room, lumps broken by hand, and coal shoveled to stokers; amount used per year, 36,000 tons.

	Cost per ton.	Cost per year of 365 days.
Unloading coal from cars and trimming.....	$0.03	$1,080.00
Wheeling coal, 2 men day and 2 men night, at $15 per week		3,120.00
Shoveling coal and operating stokers, 6 men day and 6 men night, at $25.00 per week..		15,600.00
Repairs: 5% of $5,000.00.....		250.00
Depreciation: 5% of $5,000.00.....		250.00
Interest: 6% of $5,000.00.....		300.00
		$20,600.00

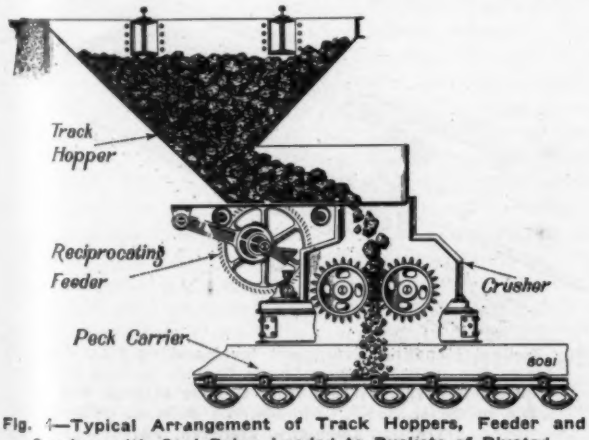


Fig. 4—Typical Arrangement of Track Hoppers, Feeder and Crusher with Coal Being Loaded to Buckets of Pivoted Bucket Carrier.

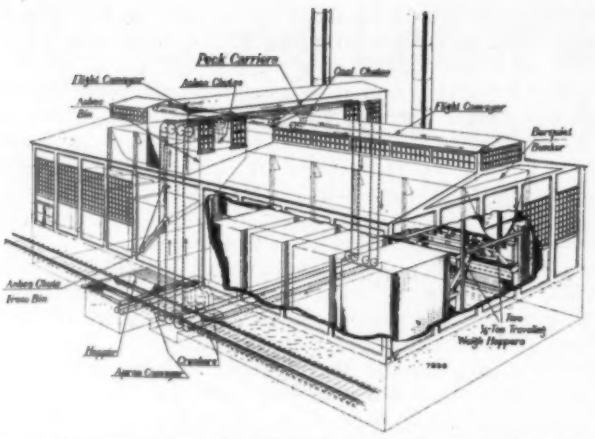


Fig. 6—Boiler Room with Peck Pivoted Bucket Carriers for Elevating Coal and Ashes and Roller Tank Conveyors for Distributing Coal in the Overhead Bins. Citizens Gas & Electric Company, Waterloo, Iowa.

BOILER ROOM EQUIPPED WITH COAL AND ASH-HANDLING MACHINERY AND OVERHEAD BIN.

Investment for this equipment $20,000.00; amount of coal used per year, 36,000 tons.

	Cost per ton.	Cost per year of 365 days.
Unloading coal from cars and conveying to bin	$0.03	$1,080.00
Operating conveyor and feeding ashes to it, 1 day man at $25.00 per week, and 1 night man man at $15.00 per week		2,080.00
Operating stokers, 3 men day and 3 men night at $25.00 per week		7,800.00
*Repairs: 5% of $20,000.00		1,000.00
Depreciation: 5% of $20,000.00		1,000.00
Interest: 6% of $20,000.00		1,200.00
		$14,160.00
Yearly saving		6,440.00

*It has been proved by experience that this figure is higher than necessary, and it was adopted simply as a very liberal percentage which would not be open to question.

This shows a saving of over $6000 per year on an additional investment of about $15,000, and this comparison of machinery equipment is made against a trestle where the unloading of the coal is comparatively easy, so that the saving comes simply in the mechanical handling and crushing of the coal, in the gravity feed to the stokers, and in the handling of the ashes by machinery. If a mechanically equipped plant was compared with a plant where the coal is shoveled from the cars, in addition to the other hand labor, the saving would, of course, show up even better. To this saving should be added the saving in fuel due to the more efficient operation of the stokers in the mechanically equipped plant, which, as given above would probably amount to not less than $5400 per year.

The same thing is true, but to a lesser degree, in a hand-fired boiler room for, while the coal has to be shoveled to the furnaces, it can be prepared and delivered to convenient points so that the labor is reduced to as low a point as is possible with this method of firing. Also, with a neater and more ship-shape boiler room the efficiency is apt to be higher and the work more attractive.

Fig. 1 shows a stoker-equipped boiler room with spouts from an overhead bin to the stoker magazines, and Fig. 2 shows another boiler room equipped with stokers, but without any mechanical equipment for handling the coal and breaking up the lumps. The contrast is very striking, and it is not hard to imagine that the efficiency is considerably higher in the former plant.

Provisions for Coal Storage.

Since the overhead bins are an expensive type of storage they are usually built to hold not over three or four days' supply of coal and an additional reserve storage of a cheaper type is located at some other point as convenient as possible. The necessity of this reserve storage is greater now than ever since coal shipments are so uncertain and coal is frequently so hard to get.

It is a very serious matter, especially to a public service corporation, to run any chances of having to close down the plant for lack of coal, and the loss in money and reputation from interruption of service would soon amount to enough to pay for a large reserve coal supply and the equipment for handling it.

In some cases the reserve supply has to be drawn on at quite frequent intervals while in other cases, where coal shipments are received more regularly, the reserve is more of an insurance and not often brought into use. In the latter case little labor will be required for the small amount of handling to and from the reserve, and little investment for labor-saving equipment for this purpose is justified; while in the former the labor-saving possibilities may justify quite a large investment.

In addition to the handling of the coal there is the handling and disposal of the ashes to be considered. While the ashes average only about 10 per cent of the amount of coal used when the coal is bituminous, the handling is more difficult and disagreeable so that it is very desirable to handle them by mechanical methods when it can be done without too great an investment. On account of the depth of pit required with most mechanical stokers, considerable labor is necessary to get the ashes up out of the pits to the boiler-room floor level and this makes more or less dirt and confusion on the operating floor. It is, therefore, a decided advantage to have a basement under the operating floor so that the ashes can be handled in the basement and to have hoppers under the stokers large enough to hold several hours' run of ashes so that the handling can be done at convenient intervals.

Methods for Handling Coal.

When coal is received by rail, or by wagons or trucks, it is usually dumped into a hopper below the track or ground level and then fed to a conveyor system, or first through a crusher and then to a conveyor. When the plant is located on a water front and the coal is received by boat the unloading is quite a differ-

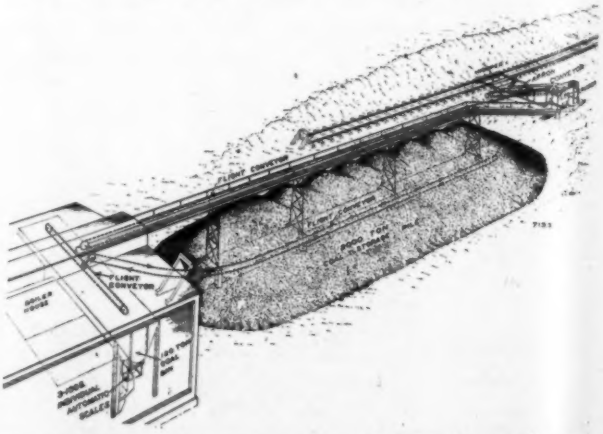


Fig. 7—Coal Handling Equipment for Handling from Railroad Cars to Bin in Boiler Room, or to Outside Ground Storage Pile and for Transferring from Outside Storage Pile to Bin in Boiler Room. Philadelphia & West Chester Traction Company, Lianerch, Pa.

ent problem, since the coal must be picked up out of the boat and delivered to the feeding hopper, after which it is conveyed as before.

The conveying of the coal is usually a case of elevating it and distributing in an overhead bin, or handling it to and from a reserve storage, while the ashes

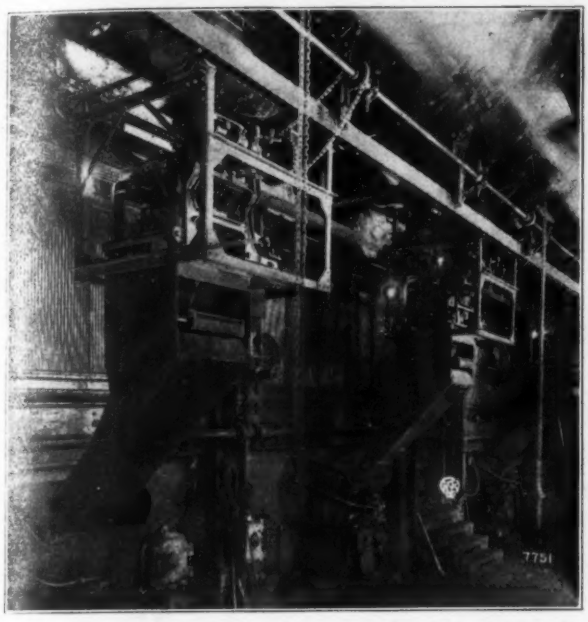


Fig. 8—Stoker Spouts at the Above Plant, Each Equipped with 100-Pound Richardson Automatic Scales.

originally have to be collected from the pits, conveyed to a convenient point, elevated, and delivered to an overhead bin, from which they are discharged to wagons, cars or boats, as the case may be.

While coal is a very easy material to convey and causes very slight wear on the machinery, ashes, on the other hand, are gritty and, when wet, quite corrosive on account of the acid formed by the sulphur in the coal and the quenching water. On this account a good many engineers favor installing one set of conveyors for handling the coal and a simpler equipment of smaller capacity for handling the ashes.

In some cases this kind of an arrangement works out to good advantage, but it usually means complications of machinery, a multiplication of driving parts, and higher operating and maintenance costs. It is nearly always better to use a pivoted-bucket carrier for handling both the coal and the ashes. The best of these machines are undoubtedly the most efficient type of conveyor that has so far been devised. The material is carried in buckets pivoted between two long pitch chains in such a manner that the upright, or load-carrying position, is maintained in both vertical and horizontal travel and the discharge is accomplished by tilting the buckets so that the material will run out. The chains have large rollers at the joints that travel on T-rail tracks on horizontal or inclined runs and are confined between double T-rail guides on vertical runs. Since the material is carried in the buckets and the chains are carefully designed to avoid wear and well protected at feeding points, an abrasive material can be successfully carried with a remarkably small amount of wear. As a rule both buckets and chain links are made of malleable iron, which resists the corrosive action of the acid water to a high degree, and the joints are made to last a remarkably long time by using high-carbon-steel pins and case-hardened bushings which give a large bearing surface and are renewable when they finally become worn. When traveling horizontally the buckets are continuous and have overlapping lips so that the material can be fed to them at any point without spilling.

As ordinarily arranged in a boiler room, these machines follow a rectangular path with the upper horizontal run over the coal and ash bins, and the lower run in a basement or tunnel and close enough to the ash hoppers so that the ashes can be fed or raked into the buckets at the various hoppers.

The one machine will, therefore, elevate and distribute the coal in the overhead bin and handle the ashes from the several loading points up to an overhead bin, and it will do this with a minimum consumption of power and at a minimum cost for maintenance. The low power consumption is due to the slow speed, usually 40 to 50 feet per minute, the large, well-oiled rollers, which insure easy movement on horizontal runs, and the fact that ascending and descending runs balance each other, except for the weight of material in the ascending buckets.

Fig. 3 shows a typical example of a boiler room equipped with stokers, overhead coal and ash bins, and a pivoted bucket carrier for handling coal and ashes. Fig. 4 shows the track hopper, feeder and crusher arrangement. The coal is unloaded from the railroad cars through the bottom doors into the track hopper underneath the track. At the bottom of the hopper is the feeder plate which is moved forward and back by a power-driven eccentric and which delivers the coal at a practically uniform rate to the two-roll crusher that crushes up the large lumps to the proper size for most efficient combustion on the stoker grates. The coal then goes into the carrier buckets which elevate it and distribute it in the overhead bin by means of a movable discharger. From the bin it is spouted through steel spouts direct to the stoker magazines. The ashes fall into hoppers underneath the stokers and are raked out into the carrier buckets, which travel along in the basement just in front of the hoppers, and the buckets carry them up

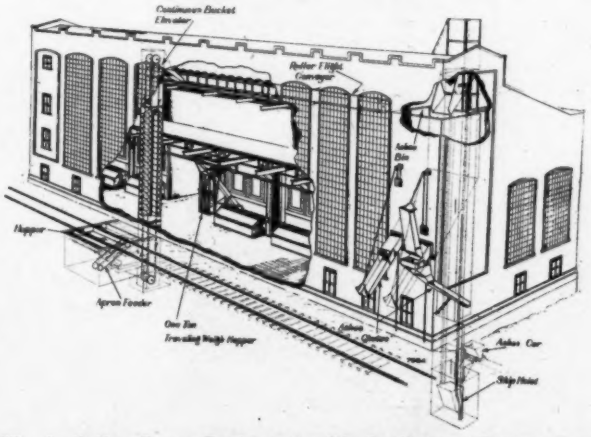


Fig. 9—Boiler Room Equipment with Continuous Bucket Elevator, Reversible Flight Conveyor, Ashes Cars and Skip Hoist. Hooker Electrochemical Company, Niagara Falls, N. Y.

and discharge them to the overhead ash bin just outside the end of the building and directly over the railroad siding. They can then be loaded to railroad cars by gravity through gates in the bottom of the bin.

The coal bin shown in the illustration is known as the suspension type of bunker. The curved plates

which form the bottom are hung from plate girders which form the upper part of the bin sides, and the girders can be supported on columns, on cross girders or trusses, or sometimes the ends of the girders are supported on the walls of the building. These suspension bunkers require much less steel than the ones where the weight is supported on an understructure instead of using the plates for tension members and for the plate girders, as well as for forming the body of the bin. The ash bin shown is of concrete, since the corrosive action of the wet ashes destroys steel plates quite rapidly. Most of the larger bins are built of concrete, concrete and brick or some similar construction of more permanent materials.

Fig. 5 shows a fairly small boiler room, equipped with stokers, overhead bins and a carrier for coal and ashes. There is no railroad siding at this plant, the coal being carted in wagons and dumped into the feeding hopper outside the building, from which it is fed by a reciprocating feeder to a two-roll crusher and then transferred with an apron conveyor to the carrier buckets which take it up and distribute it in the bin. There are four 600-horsepower Edgemoor boilers equipped with Wetzel stokers. The carrier is 70 feet long horizontally by 46 feet vertically and has buckets 18 inches long by 15 inches wide, which at a speed of 45 feet per minute will handle 20 tons of coal per hour. The carrier is driven by a 5-horsepower motor, the crusher by one of 10 horsepower and the feeder and apron conveyor by one of 5 horsepower.

When some other system is used in place of a carrier for handling the coal and ashes, it is customary to install separate equipments for handling the two materials, since there is no other type of equipment which will satisfactorily handle both. The usual method is to employ some type of chain and bucket elevator or an inclined conveyor to take the coal up to the desired level and then use a separate distributing conveyor over the bin, or when an inclined conveyor is used this machine is sometimes extended horizontally over the bin. The elevators used are known as centrifugal discharge, perfect discharge, continuous bucket and gravity discharge. The first three are used for elevating only, but the fourth can be used for both elevating and conveying.

The centrifugal discharge machine may be either single or double chain, with the buckets spaced at intervals, and the discharge is obtained by running the head shaft at the right speed to throw the material out of the buckets and forward into a chute.

The perfect discharge machine always has two chains, with the buckets spaced at intervals, and the discharge is obtained by bending the chains back around a knuckle shaft, set just below the head shaft, so that the buckets can be inverted directly over the chute.

The continuous bucket elevator may be either single or double chain with the buckets continuous, and the discharge is obtained by so shaping the buckets that the back of one bucket forms a chute for the next following bucket thus deflecting the material off into the chute.

The gravity-discharge machine always has two chains attached to the ends of the buckets, usually with swivelling attachments, and the discharge is obtained by forming the buckets to a V-shape, or to a V-shape with the end taken off, so that when the buckets are made to travel horizontaly the material slides out by gravity. This discharge may be at one point close to the turn or the horizontal travel may be extended and the same machine used also for a distributing conveyor by having the buckets push the material along in a steel trough through which it may be discharged by means of gate at intervals. Sometimes the return run is brought back in a tunnel underneath the coal pile and used as a reclaiming conveyor, the coal being fed through gates to the conveyor trough. This type of machine is therefore very flexible and can be made to follow almost any desired path in one plane. Where the horizontal run is of much length, roller chains are used.

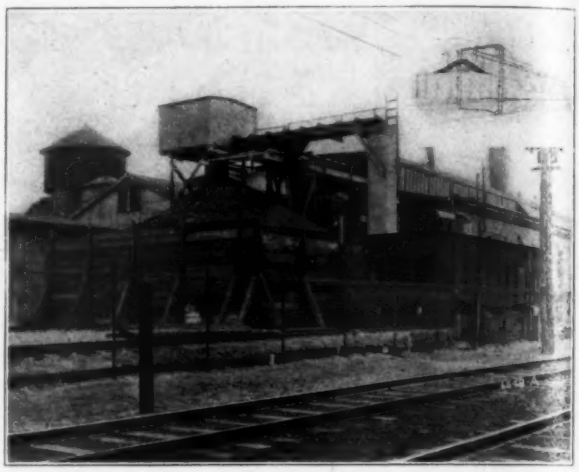


Fig. 10—Gravity Discharge Elevator-Conveyor Handling Coal from Railroad Cars to Flight Conveyor, Delivering to Boiler Room Floor, or to Ground Storage Pile. Also Reclaims from Ground Storage Pile and Delivers to Flight Conveyor. R. H. Comey & Company, Camden, N. J.

All these machines are suitable for coal, but the centrifugal discharge and sometimes the perfect discharge machines are the ones most suitable for ashes, and when they are used for ashes the best practice is to use malleable-iron chains with case-hardened steel bushings and chilled-face sprocket wheels.

For conveying coal horizontally or at an incline the simplest and best machine is a flight conveyor, which consists of a steel trough and one or two chains fitted at intervals with flights or pushers to push the coal along until it is discharged over the end of the trough or through gates at desired intervals. The flights either slide along on the trough and slide back on flat steel or angle steel tracks, usually placed directly over the trough, or sometimes the flights are fitted with shoes or rollers which slide or roll on tracks and suspend the flights just above the trough.

Where large double-chain machines are used, for instance, for handling lumpy coal, the chains are usually of the roller type, that is, with rollers at each joint, and steel tracks are provided for the rollers to travel on. These machines are excellent conveyors for coal, which is easy to push along in a steel trough, and they are comparatively inexpensive to install and to operate.

Use of Belt Conveyors.

Belt conveyors are also used extensively for conveying and distributing coal and are especially suitable for long runs and high capacities. They consist of a woven belt, usually a rubber-covered one, which passes around pulleys at each end and is supported all along its length on idler pulleys spaced at quite close intervals. The coal rides along on the belt and the idlers on the carrying runs have three or more pulleys,

set so that the outer pulleys bend the edges of the belt upward and give it a troughed shape to keep the material from spilling out sideways. The material is discharged over the end or intermediate discharge can be obtained by means of a movable discharger, which has two pulleys around which the belt passes in such a manner that the material is thrown forward into a chute leading off to one or both sides.

While coal is very easy to convey horizontally or at an incline, ashes are quite a difficult problem on account of their gritty and corrosive nature. They are best carried in the buckets of a carrier or they can be elevated with an ordinary bucket elevator, but scraping them along is very severe service for any machine, though a modified form of flight conveyor, known as a block-chain conveyor, or drag-chain conveyor, is used to a considerable extent with varying success. Suction systems for sucking the ashes through pipes are also used with good results. The suction is created either by means of an exhauster fan or a steam jet, used like an injector and the ashes are fed by hand, through openings into the pipes, at the proper rate. In small boiler rooms the ashes are usually shoveled into a wheelbarrow or industrial car and delivered to a vertical bucket elevator which discharges to an overhead bin or to a pile in the yard.

Installation at Waterloo, Ia.

Fig. 6 shows a boiler house for the Citizens' Gas & Electric Company, Waterloo, Iowa, in which the coal and ashes will be elevated by pivoted bucket carriers, the ashes being delivered to an overhead bin for spouting down to railroad cars, and the coal being delivered to roller flight conveyors running over the bins at right angles to the carriers, and distributing the coal in these bins. The ashes will be handled from the hoppers under the stokers to the carriers by means of industrial cars. Only one-half of this power plant will be built at the present time, and only one carrier and one flight conveyor will be installed.

The track hopper is to be 18 feet long by 14 feet wide, and made of 0.25-inch steel, properly braced with angle stiffeners. Underneath this track hopper

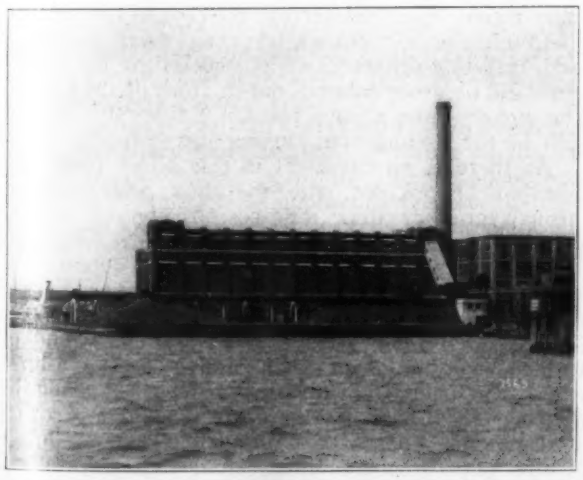


Fig. 11—Coal-Handling, Storage and Crushing Equipment. Victor Talking Machine Company, Camden, N. J.

will be an apron feeder 30 inches wide and 21 feet centers which will transfer the coal and deliver it to a two-way chute, one side of which feeds to a two-roll crusher over the present carrier, and the other side will deliver to a future two-roll crusher over the future carrier. The crushers will have rolls 26 inches in diameter by 30 inches long, each crusher being driven by a 15-horsepower motor. The apron feeder will be driven by a 3-horsepower motor, and will operate at a speed of about 8 feet per minute. The carriers will have standard 24-inch by 24-inch buckets, following a rectangular path of 74 feet vertical centers by 84 feet horizontal centers, and they will operate at a speed of 50 feet per minute, and have a capacity of 60 tons of coal per hour, or an equivalent volume of ashes.

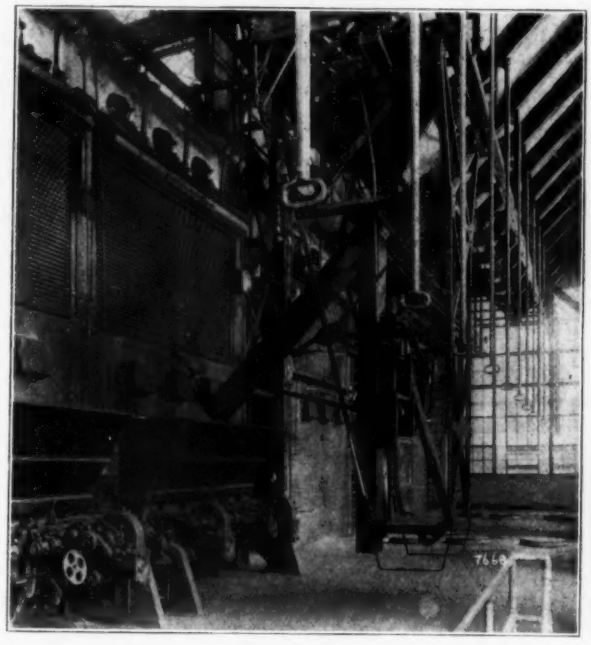


Fig. 12—Traveling Weighing Hopper Arranged to Spout Coal to Stokers or to Hoppers Under the Floor in Front of Refuse Burning Boilers. Victor Talking Machine Company Plant.

The roller flight conveyors will have flights 19 inches long by 8 inches deep spaced every 24 inches, each conveyor being 86 feet centers and operating at a speed of 100 feet per minute. A 7.5-horsepower motor will be used to operate each conveyor. The coal bins will be built of steel of the suspended type, supported on steel columns. Underneath the bin will be two 0.5-ton, motor-operated, traveling weighing hoppers for delivering to two rows of boilers. The first half of the plant to be built will have space for eight 600-horsepower boilers or a total of 4800 horsepower so that when the future half of the plant is added there will be a total of 9600 horsepower. The stokers in this case wil be Green chain-grate type stokers.

Fig. 7 shows a boiler room with three boilers equipped with type "E" stokers, and having an overhead suspension bunker of 120 tons' capacity and an outside storage pile of 2000 tons' capacity. The coal is transferred from the track hopper to the crusher by means of an apron feeder and then goes to a roller flight conveyor which either takes it all the way over the bin in the boiler room or delivers it to the outside storage pile. Underneath the storage pile there is another flight conveyor in a concrete tunnel, with gates in both sides of the tunnel, so that the stored coal can be fed to the conveyor and taken up to the distributing conveyor over the bin. Each of the three

spouts to the stoker magazines is equipped with a 100-pound Richardson automatic scale, which automatically weighs the coal and records the amount used by each boiler. These scales and the overhead bin are shown in Fig. 8.

Fig. 9 shows a boiler room for the Hooker Electrochemical Company, Niagara Falls, N. Y., in which the coal is elevated by a continuous bucket elevator, and distributed by a reversible flight conveyor over the coal bin. The ashes are handled in a car running on the basement floor, receiving the ashes from the hop-

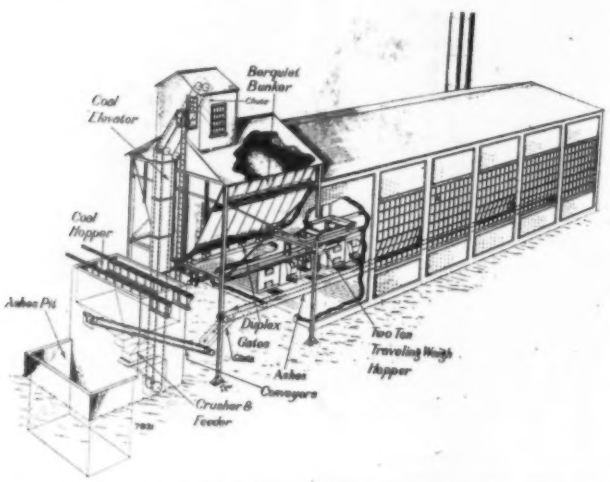


Fig. 13—Counties Gas & Electric Company Installation, Showing Coal-Handling System in Use.

pers under the stokers, and delivering them to a skip hoist which dumps them into the elevated ashes bin at one end of the building. The track hopper is 12 feet square and constructed of 0.25-inch steel. Underneath this track hopper is an apron feeder 30 inches wide by 8 feet centers, delivering to a 28-inch by 36-inch two-roll coal crusher.

From the crusher, the coal goes into the continuous bucket elevator, 74 feet centers, constructed with a double strand of 18-inch pitch, steel-strap, steel roller chain, with buckets 17⅝ inches deep by 8 inches projection by 16 inches long, continuously attached thereto. This elevator delivers to a reversible flight conveyor with 8-inch by 19-inch roller flights attached at two-foot intervals to a single strand of No. 730 malleable-iron chain. The coal-handling machinery has a capacity of 75 tons per hour. The ashes cars, which are standard 40-cubic-foot side dump, deliver to a 45-cubic-foot skip, which has a vertical lift of 83 feet. The motors used are 20 horsepower for the coal crusher and feeder, 10 horsepower for the coal elevator, 15 horsepower for the flight conveyor, and 15 horsepower for the skip hoist. Underneath the coal bin there is a one-ton motor-propelled weighing hopper. The ashes can be delivered either to railroad cars or, by means of an additional chute, to wagons.

Fig. 10 shows a hand-fired boiler room, using about 20 tons of coal per day, where 600 tons of coal can be piled on the ground out at one end of the building by means of a gravity-discharge elevator conveyor, which follows a rectangular path, and thus encircles the pile. There is also a flight conveyor which runs into the boiler room and piles coal on the floor in front of the boilers. When coal is being unloaded from cars it is elevated by the gravity-discharge machine and either delivered to the flight conveyor to be taken direct to the boiler room or discharged to the storage pile. When the stored coal is wanted, it is fed through tunnel gates to the lower run of the gravity discharge machine and taken up to the flight conveyor.

Installation at Victor Plant.

In Fig. 11 is shown the plant of the Victor Talking Machine Company, Camden, N. J. At this plant, coal is unloaded from boats by means of a locomotive crane operating on a trestle and equipped with a clam-shell bucket. The crane deposits the coal in a weighing car or larry, operating on the same track, and then pushes the car either to the track hopper, where the coal is fed to the conveyor equipment, or to some point along the storage pile where it can be dumped underneath. The crane also distributes the coal over a larger storage area along the trestle, so as to give a total storage of about 7000 tons, and when this coal is wanted, it is picked up by the clam-shell bucket and again transferred by the weighing car.

From the track hopper the coal is fed by means of a reciprocating feeder to a crusher, and then goes to an inclined pivoted bucket carrier, which, at the head end, delivers to another pivoted bucket carrier that distributes the coal in the overhead bin. The capacity of the bin is 800 tons, and underneath it there is a one-ton motor-operated weighing hopper for delivering to the Taylor stokers. Eventually there are to be 12 500-horsepower boilers, so that the daily coal consumption may run up to 200 tons, which would mean that the overhead bin supply would last about four days. Fig. 12 illustrates the traveling weighing hopper used at this plant. The ashes are handled in cars underneath the ashes hoppers, and a skip hoist and overhead ashes bin are to be built later on.

The plant shown in Fig. 13 is that of the Counties Gas & Electric Company, at Norristown, Penn. The track comes in on a trestle about 20 feet above the boiler-room floor level, and the coal is dumped into a large concrete track hopper. From the track hopper the coal is delivered by a reciprocating feeder to a two-roll crusher, and then goes to a double-strand coal elevator which delivers it, by means of chutes, to a 300-ton overhead suspended bin at one end of the boiler room. For transferring the coal to the stokers, a two-ton, motor-operated, traveling weigh hopper is used, traveling on tracks supported on the boiler columns and on other columns out in front of the boilers. The stokers used at this plant are type "E" stokers built by the Combustion Engineering Corporation.

As there is no basement in this boiler room, the ashes are raked out onto the floor and delivered through gratings to a drag-chain conveyor moving slowly along in a trench. The conveyor delivers to an inclined machine of the same type, which deposits the ashes in a pit, from which they are removed by a clam-shell bucket operated by a locomotive crane.

The drag conveyors consist of a single strand of 12-inch wide block-type chain, sliding along in a hard white iron trough. The ashes are pushed along by the links themselves, as there are no flights or other attachments. There is also an outside reserve storage at this plant, the coal being dumped underneath a trestle, and distributed and reclaimed by the locomotive crane equipped with a clam-shell bucket.

There are all sorts of modifications and combinations of machines which are used to meet various local conditions and requirements so that each plant is a special problem in itself, and to get the best results should be submitted to experienced conveying machinery engineers.

The Importance of Scientific Feed-Water Regulation

Scientific Control of the Feed Water in Relation to the Load and Furnace Conditions Is an Essential Factor in Efficient Boiler Operation

By R. W. ANDREWS

IN considering the question of efficient boiler-feed water regulation, it is really necessary to go back somewhat and trace briefly the development of boiler feeding in general, and especially as regards the application of automatic control.

When high-pressure boilers came into use, the first concern was merely to keep water in the boiler, anywhere from the top to the bottom of the drum, and no regard was taken of any exact water level. The only real concern was to prevent burning the boiler or blowing it up. Injectors were used to force the water into the boiler against the steam pressure. These injectors were poor mechanically, as well as in design, and their operation was one of the most exasperating jobs that the boiler tender had. Consequently, the early method was to start the injector and not stop it until the boiler was entirely filled, nor would it be started again until the water was practically gone.

With the introduction of better engines came the necessity of keeping the water within a certain high limit to prevent heavy slugs of water being carried over and wrecking the engines. The injectors were improved so that they would work more easily and reliably, and pumps began to be used. That the water might not go too high and cause priming, nor too low and burn the boiler, naturally brought about the establishment of a mean water level. Then when gauge-glasses were introduced the glass was placed with the middle at this mean level. In the case of a water-tube boiler, the center line of the drum was selected. The establishment of this mean level at the middle gauge, was, therefore, purely arbitrary, and represented a point midway between two extremes at which the water tender should aim.

To maintain the water level within more restricted limits demanded more constant attention on the part of the operators, and naturally brought about some means of automatically maintaining this level. Numerous crude and unsatisfactory types of automatic machines were constructed, but the first commercial so much that the results obtained are entirely obsolete and inefficient.

The first commercial regulator depended for its operation on a float which rode on the surface of the water and rose and fell with it. The principle of operation depended on the old standard device of a float controller for the water level in an open tank; except that in the case of the boiler regulator the situation was complicated by the pressure and temperature. Instead of using a lever or chain from the float to the control valve in the feed line, it was therefore necessary to introduce some intermediary device. This was accomplished by having the float open a pilot-valve as it rose with the water level, this pilot-valve admitting steam to a diaphragm which closed the valve in the feed line, thus shutting off the feed to the boiler. When the water level fell, the float closed this pilot-valve, the steam pressure on top of the diaphragm was dissipated to the atmosphere, and a spring opened the feed valve.

This type of regulator, like the original engine governor, was merely an application of a known mechanical device to a new use. There was no attempt to make the contrivance more efficient in its operation. As in the case of the lazy engine boy who tied the valve levers to the fly-wheel, the whole object was to relieve the attendant of a little irksome labor. There was no importance attached to the boiler feeding, as long as there was some water in the boiler at all times. Such a device was merely a mechanical water-level regulator was constructed some 30 years ago, by a Pittsburgh engineer in one of the plants of the Jones & Laughlin Steel Company. This type of regulator is still being manufactured today, with practically no changes in principle, construction, or operation; although the art of boiler feeding has advanced feeder and was in no wise a regulator or controller, as to "regulate" or "control" the water means to feed in accordance with a definite and efficient method.

To do away with the unreliability of the float, a metallic tube was used in some cases, the expansion of

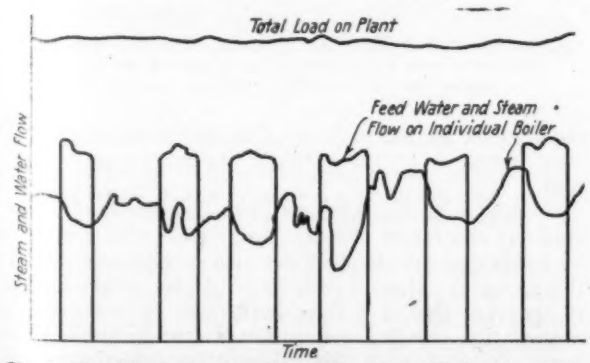


Fig. 1—The Effect of Intermittent-Type Feed-Water Regulators on Boiler Output.

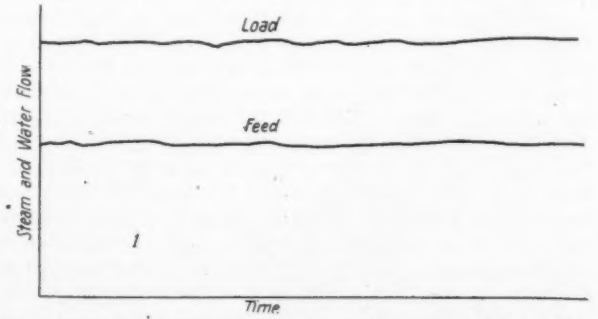


Fig. 2—The First Desired Characteristic for Proper Feed Control is that on Even Loads the Water Should Be Fed Into the Boiler at a Steady, Even Rate, Exactly Coincident with Load.

the tube being utilized to open and close the pilot-valve, which in turn operated the feed valve as before. This construction eliminated only the float difficulty. The unreliability of the other delicate parts was not

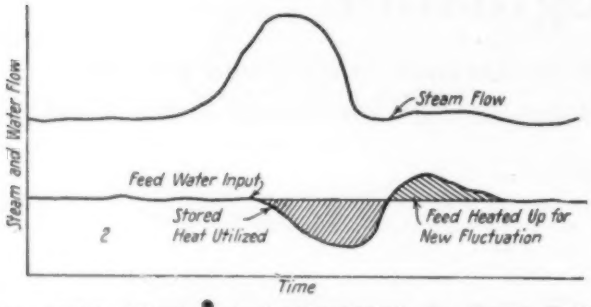


Fig. 3—The Second Desired Characteristic for Proper Feed Control is that an Increase in Load Should Be Accompanied by a Relative Decrease in Feed.

in any measure lessened; and the resultant feeding was of course not changed in the slightest.

The next big mechanical improvement was the entire elimination of diaphragms, springs, floats, pilot-valves, etc., because of their unreliability and upkeep expense. The improvement consisted in operating the feed valve by the direct expansion and contraction of a metallic tube. Until a few years ago, this was the biggest step forward in this important branch of boiler operation. Not only was complication of delicate parts removed, but maintenance and upkeep cost was reduced to the minimum. A positive and reliable operation was insured, based upon the natural law that metal when heated will expand, and when cooled will contract. Furthermore, the force exerted by the expansion tube amounted to several thousand pounds, whereas in other constructions the operating force was only a few pounds, and was frequently overcome by friction or binding of parts.

While it was generally conceded that this construction and principle was the most reliable and durable, yet mechanical superiority alone was not enough. The art of boiler-feeding had not changed for over 25 years, except in these improvements of mechanical features. Until a few years ago the only requisite was to keep the water level right at the middle gauge, and as has been shown this was purely an arbitrary level. In the meantime, however, all the other operations in the boiler room had undergone revolutionary changes, and practices that were approved ten or fifteen years previously were now not even countenanced.

Importance of Scientific Regulation.

Based upon years of specialization in boiler-feeding, it had begun to be realized that a boiler-feed regulator should be more than a mechanical device. It had been found that there were many ways of putting the same amount of water into a boiler during a given time, and that the efficiency, capacity and upkeep were affected by these various methods to a far greater extent than was generally realized. In other words, a boiler-feed regulator should not only keep a proper water level and supply of water in the boiler, but in addition should control the input of this water so as to actually aid the boiler in the maintenance of capacity and efficiency.

Let us consider what is going on in a boiler, and from this determine just how it should be fed to give maximum capacity and efficiency.

Suppose the temperature of the feed water is 180 degrees, practically 200 degrees colder than the boiler temperature. To make a pound of steam it is necessary to first heat the water 200 degrees, thus adding 200 heat units, and then to evaporate it by adding 845 units. That is, 20 per cent of the furnace heat must be utilized to heat the incoming feed water up to steam temperature.

If the boiler has practically no storage space, that is, if it would go dry were the feed cut off for only a short time, then it is necessary that the slightest change in load be accompanied by a corresponding change in the inflow of feed water. But an actual boiler holds a considerable volume of water, and when a demand for an additional supply of steam occurs, it is not necessary to immediately increase the supply of feed. Part of the water already within the boiler and at boiler temperature can be evaporated into steam, and this process may continue until the water has dropped to the lowest permissible level. Conversely, when the demand for steam falls off, it is not necessary that the amount of feed water be simultaneously decreased. On the other hand, the amount of water in the boiler can be increased so that the heat which would otherwise be lost is saved, and utilized by heating additional feed water.

Suppose for an example that the load on a boiler is suddenly increased by 100 per cent. If the rate of feeding water was increased at the same time by the same amount, then the furnace would have to generate 100 per cent more heat at once in order to keep up the steam pressure. This, of course, cannot be done, and therefore the steam pressure drops somewhat, and the heat stored in the water is called upon to make steam. Obviously, the last thing to do under such circumstances is to inject a great volume of cold water into the boiler.

If the rate of feeding does not increase when the load increases, then the additional feed water need not be heated and the momentary load on the boiler is increased by only about 80 per cent, since the amount of heat required to heat the feed is about 20 per cent of the total. If the feed water is cut off entirely when

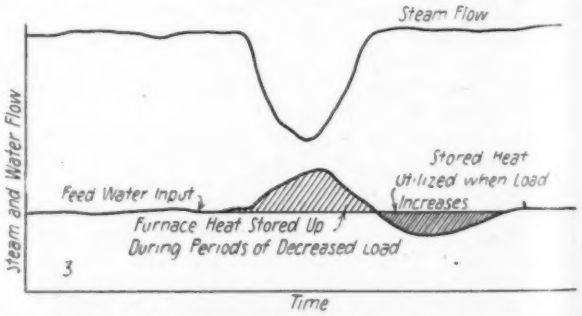


Fig. 4—The Third Desired Characteristic for Proper Feed Control is that a Decrease in Load Should Be Accompanied by a Relative Increase in Feed.

the load jumps 100 per cent, then the momentary overload demanded of the furnace amounts to only 60 per cent.

Again, take for a supposition that the load on the boiler is absolutely constant and even—with the speed of stokers and draft regulated in exact proportion. If the water is injected intermittently in great slugs, it is apparent that it will be impossible to maintain the evaporation steady, or to maintain steady steam pressure. Instead, with this intermittent injection it will be necessary to greatly force the fires at times and

practically bank them at others. An example may bring this out more clearly. Suppose we have a tea-kettle partly full of water on a stove, and the fire turned just high enough to cause the water to boil. Now, if a cup of cold water should suddenly be poured into the tea-kettle, all boiling would stop and in order to keep the water boiling, it would be necessary to turn up the fire materially, meaning a substantial waste of heat. Even then there would be an appreciable stoppage of the boiling. But if the same cup of cold water is poured in slowly and continuously, the fire can be maintained at the same even rate and the rate of boiling will not be disturbed. It is the same way in the case of a boiler, except that in this latter instance we are dealing with tons of water instead of cupfulls.

Requirements of Boiler-Feed Operation.

The first desired characteristic for proper feed control, therefore, is that on even loads the water should be fed into the boiler at a steady even rate, exactly coincident with the load.

Practically, however, it is hardly feasible, except in rare cases, to maintain the same steady demand on the boiler at all times. In other words, the load fluctuates slightly or violently, as the case may be. A little consideration will show that if the feed to the boiler is maintained at a steady rate during such fluctuations in load, the most efficient result will not be obtained. A casual consideration would make it seem that the feed input should be changed directly with the fluctuating load, so that the water flowing into the boiler would exactly balance the water going out in the form of steam. This, however, accomplishes only one thing, namely, to maintain the amount of water in the boiler as nearly constant as possible; but a constant amount of water, or a constant level at any one particular point, means nothing, either as regards efficiency, capacity, or safety.

Take again the example of the tea-kettle, and assume that it was desired to boil the water more violently (make more steam) than previously. This could be done in two ways: First, by turning the fire up higher, or, second, by discontinuing the pouring of cold water into the tea-kettle. In the case of the boiler, however, it is impossible to instantaneously force the fire. This not only takes several seconds, but usually several minutes. Consequently the load

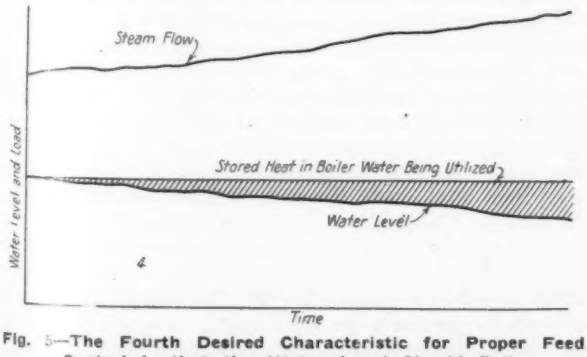


Fig. 5—The Fourth Desired Characteristic for Proper Feed Control is that the Water Level Should Fall Coincident with an Increase in Load.

increase, meaning a greater volume of steam and consequently a greater amount of heat, can be supplied only by the steam pressure dropping so that a lesser amount of heat per pound of water is necessary to turn the water into steam. This means of course a decrease in efficiency on the generating end.

It is therefore clearly apparent, inasmuch as it is impossible to regulate the fire coincident with fluctuating load, that the feed should be decreased coincident with an increase in load. This is necessary in order that the heat from the furnace which formerly had

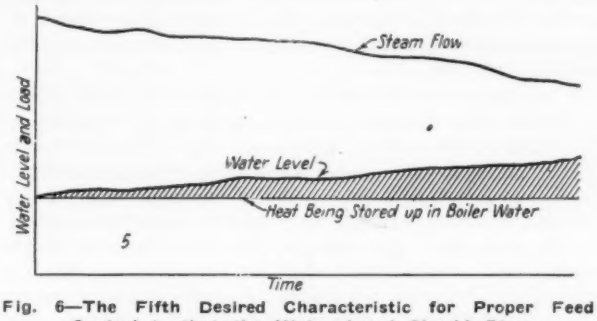


Fig. 6—The Fifth Desired Characteristic for Proper Feed Control is that the Water Level Should Rise Coincident with a Decrease in Load.

been utilized to heat up the incoming feed water to steaming temperature, can now be utilized to help take care of the increased demand for steam.

The second desired characteristic for proper feed control, therefore, is that an increase in load should be accompanied by a relative decrease in feed.

Conversely, the third desired characteristic is that a decrease in load should be accompanied by a relative increase in feed; so that the heat from the furnace which previously had been utilized in making steam is now stored up in the increased amount of feed water, instead of being wasted up the pop valve or through the stack.

While a decrease in feed with an increasing load, or an increase in feed with a decreasing load, can aid the boiler for only a short time, yet on a long continued increase or decrease in load that period of time is more than sufficient to allow the fires to be changed correspondingly, and consequently eliminate variations in pressure or wastage of furnace heat. The minor load fluctuations can be entirely taken care of without change in furnace conditions, solely by the scientific regulation of the feed water.

A boiler has a large water capacity. In the ordinary 500-horsepower water-tube boiler, with the water level near the middle of the drum, one inch vertical depth of water weighs approximately 1250 pounds. In other words, this one inch of surface water when evaporated will give rated capacity of 500 horsepower for five minutes. The water in the boiler is at the same temperature as the steam, latent heat only being required to turn it into steam. In the case of the 500-horsepower boiler running at rated capacity —to maintain the water at the same level at all times means that 250 pounds per minute, or 15,000 pounds per hour, must be injected. To heat this incoming water to the same temperature as that in the boiler, 20 per cent of the furnace heat must be used. It is therefore clearly apparent that if the feed input be stopped, and instead the stored water in the boiler is allowed to evaporate, it would take 20 per cent less furnace heat; or conversely, with the same amount of heat as formerly, a 25 per cent greater capacity will result if the feed-water input is shut off. Remembering again that a drop of one inch will give water sufficient for rated capacity for five minutes, it follows that a 25 per cent greater overload can be carried for each inch drop in water level when the feed is cut off.

The fourth desired characteristic for proper feed control, therefore, is that the water level should fall coincident with an increase in load; so that the stored

up thermal capacity in the boiler itself can help take care of such increase in load.

Again, the fifth desired characteristic is, that the water level should rise coincident with a decrease in load; so that the period of light load can be utilized to store up thermal capacity in a large volume of water, which is available for use on the next sudden heavy demand.

In other words, the storage capacity of the boiler is utilized in the same manner as a storage battery.

Boilers, however, differ very materially in design, construction, water capacity, steam capacity, furnace construction, and minor details. A boiler-feed regulator should therefore be installed and operated according to the type, design, and construction of the boiler, so as to obtain the best possible results for those conditions. Furthermore, the fluctuations in load on different boilers and in different plants vary through a very marked range. The boiler-feed regulator should also, therefore, be installed according to the load conditions under which the given type of boiler is operated.

The five desired characteristics for proper feed water control, however, can be universally applied to all types of boilers and under all operating conditions, but they must be applied in a different manner and to a greater or lesser degree. For example, with a sudden change in load from 400 horsepower to 420 horsepower, the momentary decrease in water input should obviously not be as great as for a sudden increase from 400 to 600 horsepower. Or, the water level can not be varied in one type of boiler from light load to peak load as much as in another boiler which has much greater steam space, etc.

Methods of Boiler-Feed Regulation.

There are two methods of boiler-feed regulation—hand and automatic. In the smaller plants where the feed water is regulated by hand, this is usually taken care of by a fireman. The fireman, however, has many duties and cannot give to the regulation of feed water the time that is necessary to insure satisfactory results. Even though time is available, you are dealing with the human element, which means that the average man will not devote any more labor to his duties than is absolutely required. The result is that the water input is not changed until the water goes too high or too low. Then the valve is either closed or opened and left in that position until the water is again too high or too low. A brief resume of the desired characteristics for proper feed control shows that such operation is inefficient. The water may be too low just at the time when additional capacity is required. The feed valve being opened up at the same time means that the fires must be forced to a far greater extent than should be necessary, and this means that a large proportion of heat is lost. Or it may be that the load is changed very materially, either up or down, while the feed input is not being changed at all. This again is inefficient.

In the larger plants a water tender is usually employed, whose duty is to take care of the input of water to a number of boilers. If he is taking care of eight boilers, each boiler can receive only 12.5 per cent of his time, and this is usually cut down to 8 or 10 per cent due to time between boilers, losses, etc. Starting with No. 1 boiler the feed valve is opened up because the water level is too low, not because of a change in output, but merely because of the water level. By the time he gets to No. 1 boiler again, the water may be too high or still too low, and an adjustment is again made, not in any relation whatever to output or efficiency, but purely in relation to level of water.

In the case of hand feed, the water tender and fireman are working at cross-purposes. The fireman

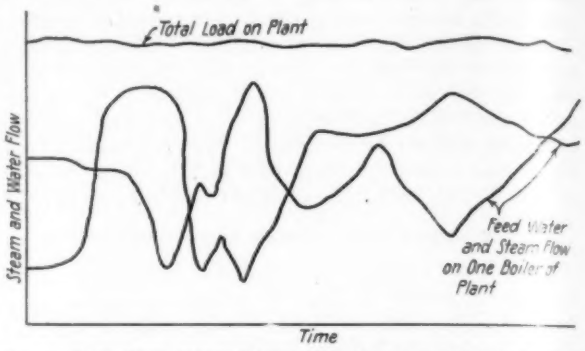


Fig. 7—This Test Chart Shows the Effect of "Hit and Miss" Hand Feeding on the Boiler Capacity.

assumes that the pressure gauge and steam-flow meter readings indicate the load, whereas the accuracy of the readings may be entirely destroyed and their utility nullified by the water tender feeding water entirely according to the level in the gauge glass, which may or may not correspond to load. Fig. 7 shows simultaneous readings of feed-water input and steam output of a boiler forming one unit of a battery on which there was a uniform constant load. The fireman had no knowledge that his work was being observed and of course relied entirely upon the water-column level to guide him in regulating the feed water. The disastrous effect on capacity of such "hit and miss" regulation is very clearly apparent from even a casual observation of this chart.

Some engineers state, "My load is absolutely constant, and consequently hand feed is perfectly efficient." It may be entirely true that the load is constant, but this is true of the total load on the battery of boilers only, and not of the load on each individual boiler. In other words, with say six boilers, there may be a total load of 2400 horsepower, but this does not by any means indicate that each boiler is carrying 400 horsepower. Instead, it is very likely that some boilers are delivering considerably above 400 horsepower, while the others are carrying considerably below 400 horsepower. An improper manipulation of the feed valve, and improper feeding of the water will change the steaming output of the individual boilers to a very marked extent. It is nothing unusual for the output of a boiler to drop 50 per cent or more in less than a minute's time, due entirely to the sudden opening of the feed control valve. If one boiler in the battery of six drops its capacity 50 per cent, the other boilers must carry this drop in load. Or if, on the other hand, one boiler, due to a forcing of the fires or a sudden decrease in the input of water, carries a much greater load than formerly, then the other boilers must decrease their output with a consequent waste of furnace heat up the stack or through the pop valves. It is therefore clear that each boiler should receive its input of feed water dependent solely on the load and furnace conditions of that boiler. This is an impossibility with hand feeding.

From the foregoing it is apparent that while hand feeding may actually keep water in the boiler, it is done at the sacrifice of efficiency and output. It is,

therefore, necessary that some method be provided whereby every individual change in boiler output or furnace condition should effect a change in water input in accordance with the desired characteristics given in the foregoing. This means a reliable type of machine designed so that any other operation than that given is impossible. This article of necessity cannot be devoted to a comparison of different constructions which might give these results, although it is obvious that a rugged machine without delicate or wearing parts should be used.

Probably the most thorough and careful test ever made on a feed water regulator is shown graphically by test chart in Fig. 8. Not only were all readings taken manually, but in addition special recording instruments were installed to check the accuracy of the manual readings, and to obtain graphic, permanent records.

This test was made in one of the plants of the United Gas & Electric Engineering Corporation, the Elmira Water, Light & Railway Company, at their

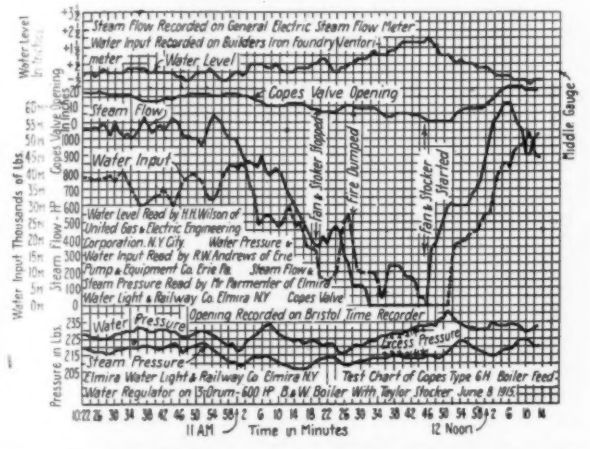

Steam Flow Recorded on General Electric Steam Flow Meter
Water Input Recorded on Builders Iron Foundry Venturi Meter
Water Level
Copes Valve Opening
Steam Flow
Water Input
Water Level Read by H.H. Wilson of United Gas & Electric Engineering Corporation, N.Y. City
Water Input Read by R.W. Andrews of Erie Pump & Equipment Co. Erie Pa.
Steam Pressure Read by Mr Parmenter of Elmira Water Light & Railway Co. Elmira N.Y.
Water Pressure
Steam Pressure
Opening Recorded on Bristol Time Recorder
Fan & Stoker Started
Fire Dumped
Fan & Stoker Stopped
Middle Gauge
Water Level
Water Input Thousands of Lbs.
Steam Flow - Lbs.
Copes Valve Opening
Pressure in Lbs.
Elmira Water Light & Railway Co. Elmira N.Y. | Test Chart of Copes Type GH Boiler Feed-Water Regulator on 15 Drum - 600 HP. B & W. Boiler With Taylor Stoker, June 8 1915
11 AM
Time in Minutes
12 Noon

Fig. 8—Test Chart Showing a Scientific Regulation of Feed and Water Level in Conjunction with Load Changes.

instigation, and under the supervision of their test engineer.

A careful analysis of this test shows that at all times the regulator admitted the water and controlled the water level in the most efficient manner possible. An even, continuous feed was maintained on steady loads. An increase in load was accompanied by a decrease in feed, and vice versa. A lower water level was maintained at heavy loads, but as the load dropped off the water level was raised. In other words, heat was stored up in the increased volume of water during light loads, and this stored thermal capacity was available to aid in taking care of the heavy pulls.

At 11:32 a. m. the load was completely off, but the regulator did not close off the feed entirely until 14 minutes later. During this time the regulator was building up the water level to the predetermined higher level. Then, when the load came on at 11:46, this stored-up water at steam temperature was immediately available and was utilized. Note how rapidly the water level dropped coincident with the load increase. The regulator did not inject a drop of water into the boiler until after the boiler was steaming to full capacity. Furthermore, the boiler was delivering over rated capacity within five minutes from banked condition, while the steam pressure not only did not fall, but actually raised materially.

This test, from beginning to end, shows conclusively the efficient method in which the feed input should be varied under any given condition.

The rapid strides made in automatic boiler-feed regulation in the past three or four years will doubtless be surprising to some of the readers. From the writer's own knowledge, however, practically all of the large central-station plants in the United States, as well as thousands of smaller plants, are feeding their boilers by an automatic regulator which gives the method of feeding described in this article. That is, man has been made the superviser of a machine, which is more efficient than he.

In closing, an extract from the Report of the Committee on Power Generation of the American Electric Railway Engineering Association is of interest.

"A great many feed-water regulators are designed to maintain constant water level and are of a type that closes the supply positively when the water level is above the desired level and opens wide when it falls below. This method of feed control is responsible for a considerable variation in the steaming capacity of the boiler. Approximately one-fifth of the total heat supplied by the furnace, when operating at 200 pounds pressure, is represented in raising the temperature of the feed-water from 200 degrees Fahrenheit to steam temperature. The full opening of the valve may deliver water to the boiler at a rate of five or ten times the normal rate of evaporation. Thus if the feed valve remains open for any considerable time, the total heat input from the furnace may be spent in raising the temperature of the water and at this time the output of the boiler is reduced to practically nothing.

"These features of feed-water regulation are now better understood, with the result that regulators are now available which give a graduated control of the feed-water and permit a variation in the water level between any two extremes that may be fixed. The height of the water in the gauge glass, when the water level remains constant, is then some indication of the rate at which the boiler is being worked. This method of feed control enables peak loads of short duration to be carried with a more uniform working of the furnace, as sudden demands for steam will cause a fall in the water level without a corresponding increase in the rate of feed. The value of the graduated control of the feed-water supply will be appreciated when it is remembered that the water contained in the drums of an ordinary 500-horsepower water-tube boiler is sufficient to supply full rated capacity for five minutes with a fall in water level of only one inch without other feed supply."

Coal Storage Facilities and Equipment Insure Economical Operation at Reading.

The Metropolitan Electric Company, Reading, Pa., has just completed storing 20,000 tons of soft coal at its big power plant in West Reading, which insures a continuity of service throughout next winter. Part of this supply of 400 carloads of coal came from the mines recently purchased by the company at Lost Creek, W. Va., which produce approximately 80,000 tons a year.

The company is about completing the installation of a lot of fuel-handling machinery, which takes the coal from the cars, feeds it to the boilers and afterwards gathers up the ashes and dumps them in waiting cars without the necessity of any handling at all by workmen. Besides meaning a great annual saving in labor, this machinery just about doubles the former capacity of the boilers.

Effect of Soot on Boiler Efficiency

The Need for Stringent Economies Make Question of Soot Removal of Direct Interest—Comparisons of Various Methods Are Discussed

By ROBERT JUNE

Mechanical Engineer.

OF ALL sources of preventable waste, that of the formation of soot on the fire surfaces of the boiler is the most troublesome. Air leaks in the setting may be found and be hermetically sealed. Losses due to radiation may be largely eliminated by proper insulation of the pipes, and losses caused by excess air drawn through the grates may be done away with in a large degree by the installation of stokers and draft gauges. Scale can be removed by cleaning at regular intervals. It is a job usually requiring time and patience, but the periods of cleaning are comparatively far apart. The formation of soot, however, cannot be stopped by any permanent means. It is an ever present source of trouble. Its deposit on the fire surfaces of the boiler is an ever continuous process.

Soot is all but the best insulator known. In non-conducting properties it has been proved to be more than five times as effective as fine asbestos. More heat would be transmitted to boiler tubes through a full one inch wrapping of asbestos than through one-fifth inch coating of soot. The table below is from Kent's pocket book.

WATER HEATED THROUGH VARIOUS SUBSTANCES.

Thickness of each substance.....1 inch
Temperature applied to each.....310 degrees Fahr.
Temperature increase of water in each case....10 degrees Fahr.

Substance:	No. pounds of water heated.
1. Loose wool	8.1
2. Loose lampblack (soot)	9.8
3. Hair felt	10.3
4. Carded cotton wool	10.4
5. Fine asbestos	49.0

A perfectly clean boiler tube, one-eighth inch thick, will transmit 40 times as much heat as will a tube covered with one inch thickness of soot.

The loss in heat conductivity of boiler plate, due to soot deposit, may be noted in the following table:

Thickness of soot.	Per cent of loss.
Clean pipe—	0.0
1/32"	9.5
1/16"	26.2
1/8"	45.3
3/16"	69.0

Fortunately soot does not collect on all surfaces of a boiler in the same proportion. Some portions may be fairly clean while others are thickly coated. This does not lessen the fact that there is a wasteful expenditure of fuel and heat wherever a portion of the tubes are soot coated.

What Soot Is.

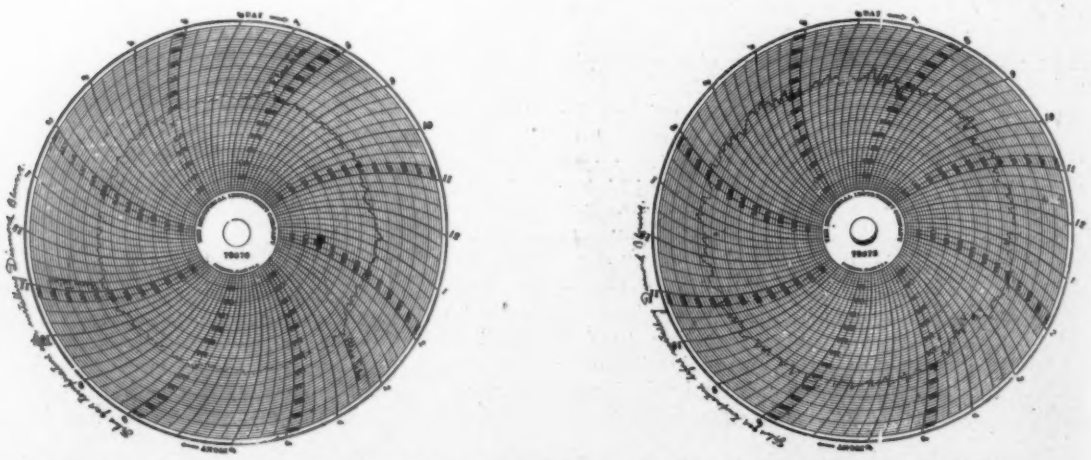
The principal constituent of "pure soot," or lamp black, is carbon. Mixed and associated with this carbon are various tar products and acids.

Soot as found in steam boilers varies considerably in appearance and composition, depending upon the grade of coal burned, conditions of combustion, and the part of the furnace from which the sample is taken. Nearest the fire the deposits formed consist largely of ash. Analysis of samples of soot taken from the first pass of a boiler shows in addition to the "pure soot" the presence of silica, alumina, iron oxide, various alkalis and sulphur dioxide.

In color soot varies from black, to gray, grayish white, grayish green, grayish blue, brown and reddish brown.

In all but the coolest portion of the setting soot is usually gritty in texture. The grains may be as large as medium sand, or as fine as cigar ash. These particles are in a plastic state when they leave the furnace and striking the lower portion of the boiler, they adhere to the tubes.

If this deposit is not removed frequently it quickly increases in amount and changes in character. The carbon burns out in part and the mass cements together. The repeated reduction in heat-absorbing surface increases the temperature of the flue gases, so that the process of cementation is continuous and constantly increasing in intensity. An extremely hard clinker-like formation results. In a short time the space between the tubes in some portions of the boiler is entirely blocked, thus materially reducing its capac-



Recording Charts Showing Flue-Gas Temperatures Before and After Installing Mechanical Soot Blowers.

ity. In this condition mining operations alone will remove the deposits.

A bad feature of these deposits is that if they are allowed to remain, the corrosive action of the various constituents of the soot is exceedingly apt to cause leaky tubes. Under the influence of heat, a ferrous carbonate is formed. The excess of air that is always present brings free oxygen in contact with the ferrous carbonate and the reaction produces ferric oxide and carbonic acid. Carbonic acid, particularly in the presence of free oxygen, acts very rapidly on the metal of the boiler. Another source of corrosion is the sulphur dioxide in the soot which changes first to sulphurous acid and then to sulphuric.

Only the boiler-insurance companies know how many boilers are condemned annually as unfit for operation, years before their natural period of service would terminate. That the number is very high we know, for cases are constantly coming to light.

Hand Cleaning Not Effective.

It is a mistake to think that soot can be removed by the hand-hose method (using steam, through rubber hose and nozzle). The use of this system arose in the sheer necessity for removing some of the deposits from the tubes. It is admittedly an inefficient and expensive process, as well as being an extremely disagreeable and, to a certain extent, dangerous task.

Two men are required, one close up to the boiler setting, frequently on a ladder (a delightful position on a hot summer day), and the other at the steam valve. The time employed is usually from 20 to 30 minutes. The nozzle is inserted, the spray of steam goes into the boiler, but whether it reaches all of the soot covered parts of that section the fireman doesn't know. There is a large section near the cleaning door which he cannot reach at all. He is using a large supply of steam and he is letting an immense amount of cold air into the furnace. When he moves to the next location, he will blow some of the soot back.

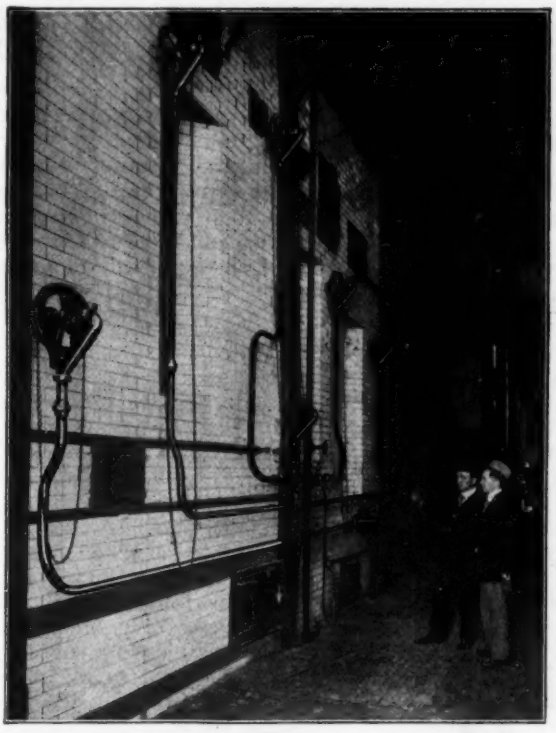
Says the author of "Furnace Efficiency":

"I was talking one time with the manager of a very modern power plant in the very modern city of Minneapolis. We got around to the subject of soot and the engineer said: 'I will show you that we keep our boiler tubes clean.' He raised the slide from one of the blow holes at the first pass in the boiler. There was a good light from the furnace just below the tubes and we had a fair view of them. They were reasonably clean. We then went to the back pass of the boiler but there was no light from the furncae there and we could not see anything. While the engineer was in search of a light, I found a piece of gas pipe about six feet in length, and thrust this through one of the blow holes in the last pass and across the tubes of the boiler. I could tell by the feeling of the pipe that there was a surprise in store for my engineer friend. The flashlight showed furrows an inch deep where I had plowed with the gas pipe across the top of the tubes.

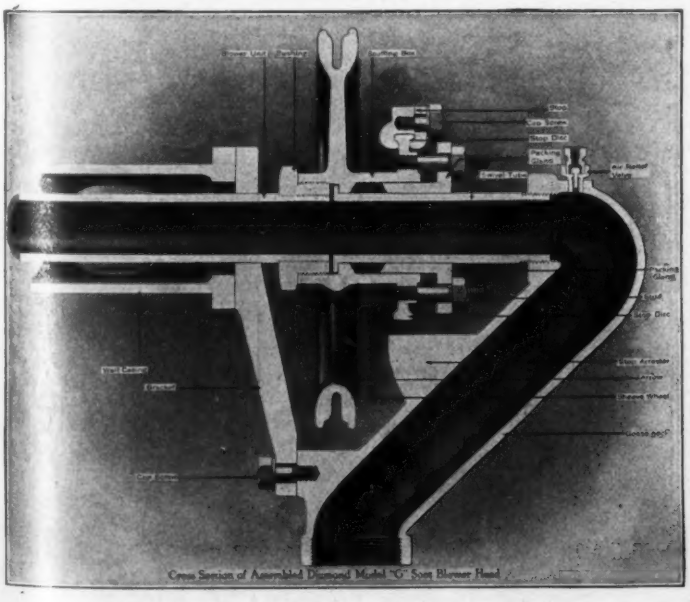
"Now it is evident that the man who had charge of cleaning these tubes had not finished the job. He had blown soot from the first pass back into the second and a double dose of soot from there back into the third. Then he had stopped. Now if things like that can happen in a well-regulated plant, what can we expect to find in plants that are not regulated?"

To clean off soot properly all of it should be blown off from the tubes. To blow it from one locality to another does not help much. It is no uncommon thing to find soot so thickly packed into the corners along the side walls for a water boiler that you could use a hoe and shovel in removing it.

You want your boiler tubes to conduct heat as rapidly as possible to the water within the tubes. If you want to keep up steam when the soot piles up, you will have to pile in more coal.



Mechanical Soot Blower Installed at Plant of Boston Edison Company, Showing New Vertical Header Piping and Use of Bends Instead of Elbows.



Cross-Section of Mechanical Soot-Blower Head.

THE FIVE ESSENTIALS IN PREVENTING SOOT WASTE.

The five essentials in preventing soot waste are:

(1) Frequency of cleaning in order to minimize the cummulative effects of increasing deposits. Tubes should be cleaned three to six times a day;

(2) Thoroughness of cleaning, in order to maintain high furnace and boiler efficiency, and prevent the destructive corrosive effects of soot accumulation;

(3) Availability of system; the soot-cleaner system should be instantly available, automatic in action, capable of rapid operation;

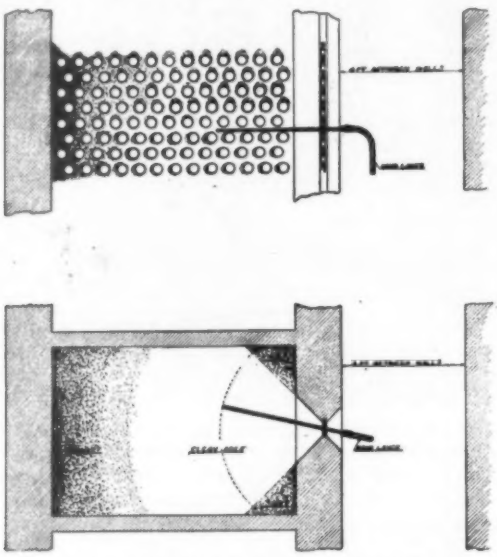


Diagram Showing Ineffectiveness of Hand-Cleaning Methods.

(4) Durability of system; the blower units should be so designed and constructed that they will withstand the stress of hard service when placed in the hottest portions of the boiler without necessity for frequent repair or replacement;

(5) Economy of operation: the soot-removing system should require less steam and labor than hand blowing; it should be so installed as to prevent the entrance of cold air into the furnace during its operation; it should pay for itself from an investment standpoint.

The modern mechanical soot blower of the best design fulfills all of these requirements. That it is a paying investment is well illustrated by the flue-gas temperature charts shown herewith, as well as by many detailed tests of which the following is typical.

SOOT BLOWER TESTS.

The following extract is from a report by J. A. Moyer, member A. S. M. E., professor of mechanical engineering, Pennsylvania College, covering a comparative test on a B. & W. boiler at the college power plant, equipped with the Diamond soot-blower system.

"The comparison was made as regards operation by making two tests with the usual method of hand cleaning the tubes with a steam nozzle, blowing them off every 12 hours. A second set of tests was made when the Diamond soot blower was used for cleaning the tubes every three hours. Clearfield coal, having a heating value of approximately 13,650 pounds B. T. U. per pound of dry coal, was used in all of these tests. The actual heating value was determined with an oxygen bomb calorimeter for each test and the efficiency then calculated on this basis. Duration of tests one and two was approximately eight hours, while tests three and four were each run for 24 hours.

Load conditions good.	Test No. 1 without tube cleaner.	Test No. 2 with tube cleaner.
Water evaporated per lb. of coal as fired, lbs.	8.06	8.72
Equivalent water evaporated from and at 212 deg. per lb. of coal as fired, lbs.....	9.50	9.97
Equivalent evaporated from and at 212 degrees per lb. of dry coal, lbs.....	9.61	10.06
Efficiency, including grate, per cent.....	68.3	71.5

Saving of coal $\frac{71.5-6.83}{.683} = 4.7\%$.

That the central stations of the country recognize the value of mechanical soot blowers is evident from their large volume of purchases of this equipment.

Illustrations accompanying this article were supplied by the Diamond Power Specialty Company.

Unique Condenser Installation at Cumberland.

After visiting the Cumberland (Md.) & Westernport Electric Railway, Charles M. Rogers, results engineer for the southern district of Henry L. Doherty & Company, reports that during his stay, the DeLaval 500-kilowatt turbine with reduction gear and direct-current generator at the Clarysville plant was started and is working satisfactorily. The interesting feature of the installation is the fact that there are no auxiliaries connected with the condenser installation. A line of wooden pipe was run up the mountain behind the plant, down to the barometric condenser and through same and discharging in the run directly in front of the plant. The difference in elevation between the source of supply and the discharging point is approximately 90 feet, and the condenser is located about midway between these two points, thereby forcing the water through the condenser which has a local head of 34 feet, and carrying it away without the use of any pumps.

The barometer at Clarysville is about 28 inches and based on a 30-inch barometer, the vacuum ranges between 28 and 28½ inches. This is undoubtedly the cheapest vacuum obtained in any of the Doherty properties.

Mansfield Company Has New Arrangement for Constant Steam Pressure.

The chief engineer of the Mansfield (O.) Electric Light & Power Company has fixed up a novel arrangement for maintaining constant steam pressure at the old plant. The normal operation of the boiler required between 8 and 10 burners. He equipped two burners with a valve operated by a solenoid, which is actuated by a contact on the steam gauge. As the steam pressure falls below a given point, it closes on this contact and opens the valve operating two of the burners. This arrangement has decreased labor in the boiler room to a point where the men do not have to touch the burners for hours at a time, and very little change is made on the feed-water supply.

Electric Plant Planned for City in India.—Best & Company, English contractors, located at First Line Beach, Madras, Southern India, have applied to the Government for a license to establish an electric lighting and power plant at Madura, 344 miles from Madras. Electric plants in Madras and Bangalore are in service. Names of electric firms in those cities may be obtained from United States Bureau of Foreign and Domestic Commerce, by referring to File No. 91505.

Application of Stokers to Moderate Sized Furnace

A Statement of the Advantages of Stokers and Operating Results Secured by a Number of Small Central Stations

By FRANKLIN G. ROGERS

SOME people have an idea that one is not warranted in putting stokers in a small plant, and there are some consulting engineers who do not recommend the installation of stokers in plants of less than 1000 horsepower, but the power-plant operator who will take such statements for granted and does not himself look into the merits of stokers is only doing an injustice to himself, as present-day installations have proved without a doubt that mechanical stokers are as essential in a small plant as they are in the large plant, and this is particularly true in the case of the smaller sized central stations which are furnishing power to their local communities.

It is assumed that in most power plants careful records of coal costs are kept and that the relation between coal cost and power developed is frequently determined.

The proper place to start a study of steam cost is at the coal pile. From 20 to 30 per cent of the combustible in the fuel may be going into the refuse pile. This is not an unusual percentage in hand-fired plants. CO_2 may be running from 5 to 8 per cent when it should be around 12 per cent, and fuel gases may be entering the stack at unnecessarily high temperatures.

Fluctuating demands for steam may be working the safety valve over-time. One pound of steam at 125 pounds' pressure (about 350 degrees, Fahrenheit) lost through the top carries with it 1193 heat units, which, of course, is not much in itself, but when it is repeated many times a day for three hundred and sixty-five days a year the total assumes alarming proportions.

Clouds of black smoke may be issuing from the stack. The visible portion of the smoke does not carry an important amount of heat-producing element, but it is an alarm signal of wrong furnace condition or operation, resulting in an invisible combustible gas which represents the real loss.

The above covers the most usual items of loss occurring in a hand-operated plant, and these can be corrected by installing stokers.

Lack of Attention in Small Plants.

In some plants there is a lamentable lack of curiosity on the part of the owners as to the coal cost of the steam that is produced in their plants and no reasonable standard is kept which the firemen are expected to approach. One case in mind, where the average daily consumption of coal was 15 tons, developed the fact

Stoker Installation at Plant of Attleboro Steam & Electric Company, Attleboro, Vt.

that no one knew what was the evaporation per pound of coal. One of the firemen volunteered the information that wasn't very good. "We are only getting about 25," he said.

The man in charge of the boiler had no idea how much water should be evaporated per pound of coal and his superior had never suggested that he find out. He held his job because he would work for the meager wage paid and because he seemed able to supply the plant with plenty of steam. His fuel bills were never questioned.

A good grade of coal containing 13,000 British thermal units was burned, but test showed an evaporation of less than 6 pounds of water per pound of coal, less than 50 per cent combined boiler and furnace efficiency. An increase of 8 pounds hand firing would have been a comparatively easy matter with a competent fireman and with proper stoker equipment 9 to 9½ pounds could be obtained regularly even with the present fireman.

Fifteen thousand five hundred and twenty-five pounds of water were evaporated per hour. To do this it required, based on a ratio of 6 to 1, 2600 pounds of coal. At a ratio of 8 to 1 the coal would be reduced to 1940 pounds, and at 9 to 1 to 1725 pounds. With coal costing $4.00 per ton there would be a saving of $1.33 per hour in the first case, $1.75 per hour in the second case.

This 9 to 1 ratio would be equivalent to 68 per cent efficiency, but with stoker equipment it would be possible to get at least 70 per cent efficiency, so that more than 9 pounds of water could be evaporated per pound of coal burned. But assuming that only 68 per cent efficiency was obtained with the stoker equipment, it can be seen that the saving in fuel over hand firing would run to quite an amount within a year. In fact, it would be such as would pay for the stoker equipment in less than a two-year period.

This may not be the average case, neither is it an exceptional case, but in any plant now hand fired it is possible to install stoker equipment which will effect savings in coal bills, which will pay for stoker equipment within a short period of time, and in addition to the saving in fuel which is brought about by the increased efficiency, it is also possible to increase the capacity of the boilers already installed, thus saving the expense of installing additional boilers in order to carry the increased load as the business develops and to abate smoke.

In addition to increased efficiency, increased capacity, and smoke abatement, proper stoker equipment will do away with manual control, substituting in its place automatic control, assuring at all times even steam pressure, regardless of the fluctuating load, which is quite common in the central stations. By means of the automatic control the coal and air supply are proportioned to the load on the boiler or boilers, the air and fuel supply being increased as the load is increased and decreased as the load is decreased, thus doing away with the frequent poping off of the safety valve and assuring ample steam at proper pressure for sudden increases of load or emergency.

Selection of Stokers.

The question of what type of stoker to install must be determined by a study of local conditions, but the following essentials should be kept in mind when stokers are being considered, namely:

Stokers should be installed which will economically burn the cheapest grade of bituminous coal, assuring smoke abatement without the additional cost of expensive arches or baffles.

Stokers should be installed which have automatic control of fuel and air, thus insuring even steam pressure, regardless of fluctuating loads.

Stokers should be installed which can be adapted to old boilers without much expense, and should be suited to local conditions.

Stoker Installation at Waterloo Plant.

Stokers should be installed which can be reinstalled should a change be made in the boilers.

This last item is very essential as one realizes that quite frequently boilers "go down" and must be replaced, while the stoker equipment installed is still in very good condition, and if the stoker equipment is not of the type so that it is interchangeable, one would be obliged to scrap good stoker equipment and purchase new equipment, if proper precaution had not been taken at the time of purchasing stoker equipment.

The writer has in mind a plant where five stokers of a standard make were installed in 1911. Four under 72-inch by 16-foot return tubular boilers, and the fifth under an internally fired boiler with 45-inch furnace. In 1912 stoker No. 5 was reinstalled under a new 72-inch by 16-foot return tubular boiler and in 1915 these five stokers and a sixth one (new) were reinstalled under three 250-horsepower water-tube boilers.

Quite frequently the claims made by stoker manufacturers are doubted by the prospective customer, but actual facts pertaining to stoker installation should be given very careful consideration, and such facts can quite frequently be obtained from the users of stoker equipment. For instance, in June, 1915, two 72-inch by 18-foot boilers in the plant of the Municipal Light & Water Company, at Waterloo, Wis., were equipped with stokers of a standard make. The prime consideration was smoke abatement as the plant is located in the heart of the village, and regardless of the direction of the wind, someone suffered. Boilers in this plant are used alternately one week each and as the load is light, coal consumption is not great, although 24 hours' service is furnished. Shortly after the stokers were installed the size and number of street lamps were increased, and instead of working on a so-called "moonlight schedule," shutting off light at 11 p. m., an every night, all-night service was adopted. This more than doubled the night load. In addition a heating system was installed and exhaust steam was utilized to heat more of the business blocks in the village. An active campaign for new business is carried on by the municipality and the day load has been materially increased by the addition of motors and by educating the public to use the many electrical conveniences now on the market. Revenue has increased while operating costs have lowered. Coal costs are actually less for the period that the stokers have been in operation than for the corresponding period previous to installation, in spite of the increased volume of business being handled. As no other changes were made in the plant the stokers do not divide the honors. The merchants in the village feel that smoke elimination alone has warranted the investment, but a saving of 15 to 18 per cent in coal bills has proved a welcome addition to the treasury.

In 1913, the Attleboro Steam & Electric Company of Attleboro, Mass., found it imperative to take immediate steps to increase the capacity of its plant, and after very careful consideration installed a well-known stoker under the boilers, with the result that before stokers were installed, seven boilers hand fired barely met the demand. Since stokers were installed the same seven boilers are carrying a much greater load and stokers are saving one pound of coal on every kilowatt-hour generated. In addition, the purchase of stokers enabled the company to defer the investment of an additional boiler an indefinite time.

In 1914, the Municipal Water & Power Company of Humboldt, Tenn., installed stokers of a standard make, and after installation reported that they were able to burn a very cheap grade of coal, had effected large savings in fuel bills, and had operated boiler at greater overload than would be possible with hand-firing, further reporting that the automatic operation of the stoker gave steady steam pressure on all loads and handles the feat without any effort. There is never any smoke and the CO_2 averages between 10 and 12 per cent.

There is no question, but that there are a large number of small plants throughout these United States equipped with stokers. Also that there are a large number of small plants throughout the United States that are not equipped with stokers, and if the operator whose plant is not equipped with stokers will give the proposition very careful consideration and will get in touch with those whose plants are equipped with stokers, he will no doubt see without much argument that he is losing money by not installing modern equipment.

According to the director of the Bureau of Mines, the loss of fuel in 1916 on account of inefficient use amounted to $500,000,000, and on account of this large loss our government is now taking steps to conserve the fuel supply, so that stokers installed in a power plant serve a two-fold purpose. First, they assist greatly in the conservation of fuel, which is desired, and will be required by the government. Second, their installation means an actual saving to the purchaser, first paying for themselves and then paying dividends, and also the installation of stokers means smoke elimination, a subject which is receiving very careful consideration in the larger cities and in a good many of the smaller cities.

Electrical Craftsmen in Annual Convention.—The Electrical Craftsmen, the members of which are Freemasons who are engaged in the various branches of electrical science and industry, recently held their second annual convention at Marquette Hotel, St. Louis, Mo. The sessions were presided over by H. P. Cherry, grandmaster craftsman. The welcome address was delivered by E. R. Kinsey, president of the Board of Public Service, who represented Mayor H. W. Kiel. Chas. F. Hatfield, secretary of the Convention and Publicity Bureau of the city, spoke for the business and industrial interests. Responses were made by Grandmaster Cherry; and Grand Secretary R. W. Peterson, of Chicago, told of the work and purposes of the organization. E. S. Hallett, chief engineer for the Board of Education, and member of the St. Louis chapter, addressed the convention. After interesting sessions and various tours, the convention ended with a banquet.

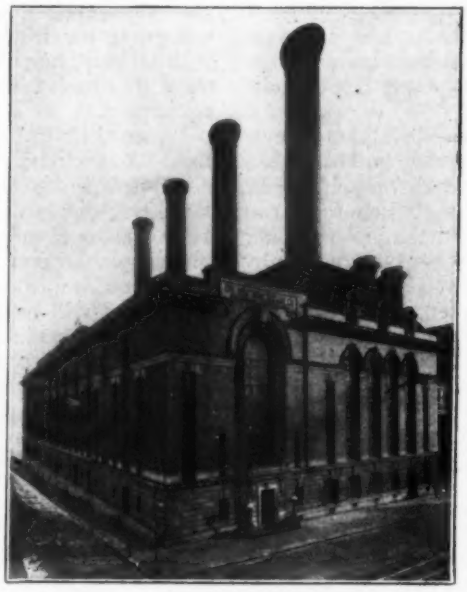
Massachusetts Electrical Contractors Will Meet.—Electrical Contractors' Association of Massachusetts will hold its annual meeting at Hotel Bancroft, Worcester, on September 20. The program, following a luncheon, will consist of a business session, and an address by William L. Goodwin of California, in which he will outline a plan which he purposes to submit to the members of the National Electrical Contractors' Association at its convention in New Orleans in October. At the evening banquet, there will be speeches by members of the association and invited guests. A report of the meeting will be conveyed to the national association convention at New Orleans. J. E. Wilson, 263 Summer Street, Boston, is Secretary.

Data on Leading Steam-Electric Plants

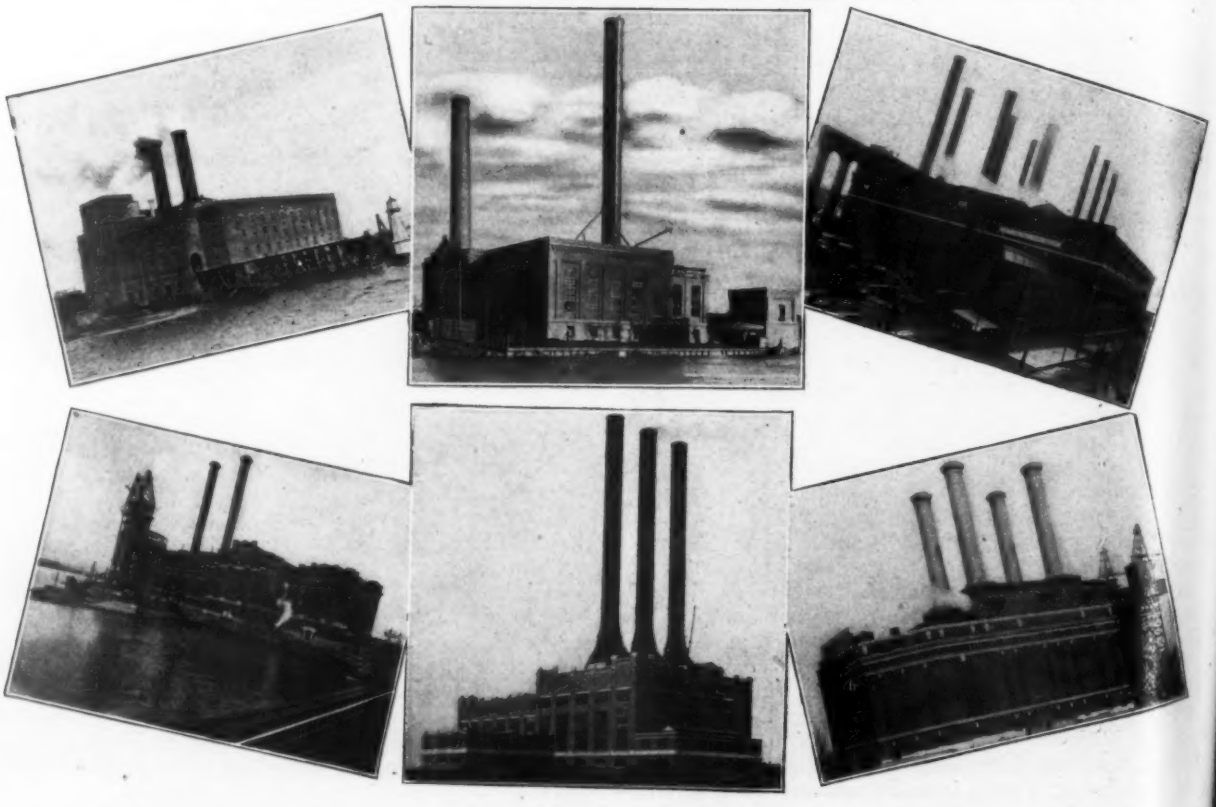
Listing of the Principal Equipment Used in the Most Modern Steam-Turbine-Driven Electric Generating Stations, Showing Trend of Present Development

EXTRAORDINARY developments have taken place in the last dozen or fifteen years in the design and operation of steam-driven electric generating plants. The most radical have been those in steam turbines which have made possible the gigantic and extremely efficient power stations of the present day. The steady increase in size of generating units during the last few years has practically revolutionized the entire engineering practice of steam power plants and has necessitated rapid developments in boilers, stokers, pumps, condensers and other plant equipment to adapt the numerous auxiliaries to the requirements of the large turbogenerators now in use.

Most timely have been the developments referred to. The large and efficient power plants resulting therefrom are meeting urgent national needs for reliable and economical power supply. In spite of difficulties connected with coal supplies, demands for electric power for industrial needs are likely to increase. Additional hydroelectric power cannot be developed rapidly enough to meet the emergency. The likelihood is therefore that additional steam-electric plants will be required and old plants will be remodeled and enlarged on the most efficient lines to increase capacities and prevent fuel wastes.



A survey of the most modern practice in power-plant design and equipment seems therefore timely. There are in this country over a score of large, efficient and new or modernized generating stations that are models of the most highly developed practice in this line. They afford splendid material for the comparative study of plant equipment that has been made on the following ten pages. Ten typical stations have been selected. To make a complete analysis of their equipment would require that three to eight or more pages be devoted to each station. This being impossible, of course, only the principal equipment has been listed in these representative stations.



Philadelphia Electric Company

STATION A-2.

Located on Schuylkill River at Christian Street, Philadelphia, adjacent to Station A-1. Erected October, 1914, to November, 1915. Two units in service, third unit now being added. Data below relate to equipment in service.

Boiler-Room Equipment.

Twenty water-tube boilers. Rating 1009 horsepower each. Steam pressure 250 pounds gauge. Superheat 150 degrees Fahrenheit. Four longitudinal steam drums. 448 four-inch boiler tubes. 128 two-inch superheater tubes. Furnace 19 by 8 feet. Babcock & Wilcox Company.

Taylor gravity-underfeed automatic stokers. 10 retorts per boiler. Driven by 15-horsepower direct-current motor. American Engineering Company.

Two stoker-driver turbogenerator sets. Curtis two-stage noncondensing steam turbine, 3600 revolutions per minute, driving through reduction gearing 200-kilowatt, 250-volt, interpole direct-current generator. General Electric Company.

Forced-draft blower for each boiler. Capacity 35,000 cubic feet per minute. American Blower Company. Driven through speed-reduction gears by 60-horsepower Terry steam turbine. Terry Steam Turbine Company.

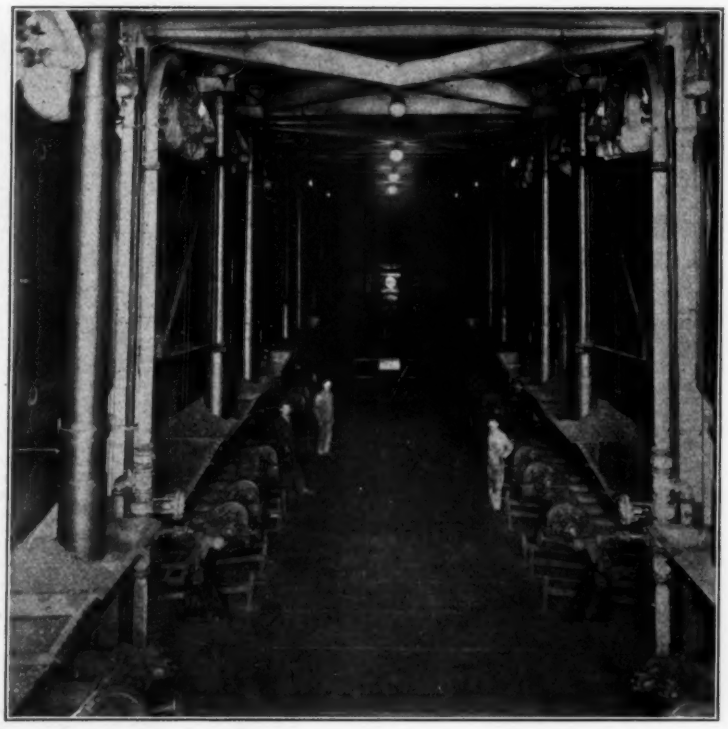
Five boiler-feed pumps. Three-stage centrifugal type. Capacity 1200 gallons per minute. Direct driven by 300-horsepower Rateau three-stage noncondensing steam turbine. Southwark Foundry & Machine Company.

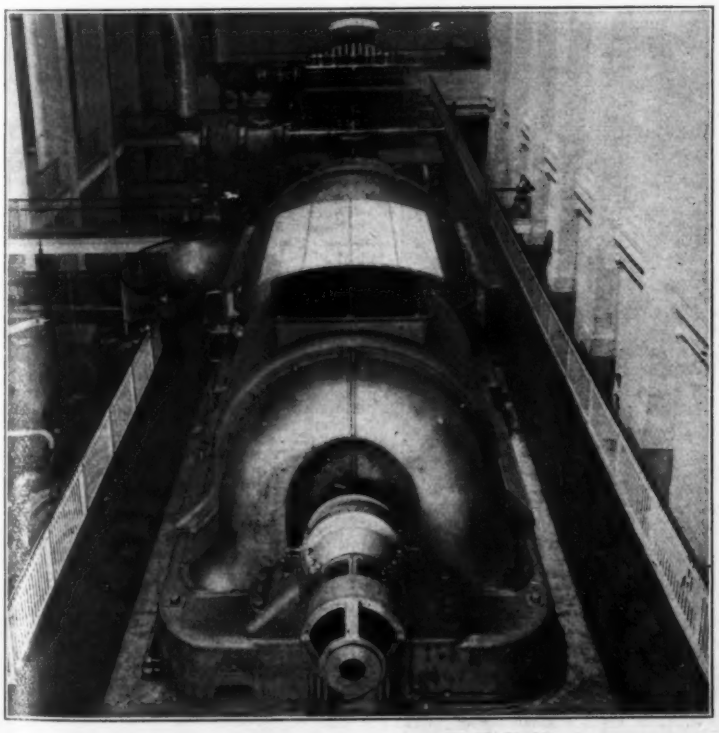
Two combined feed-water heaters and meters. Webster-Lea type. Capacity 600,000 pounds water per hour. Yarnall-Waring Company.

One steam and one electrically driven coal-unloading tower at wharf. Capacity 180 tons per hour each. Mead-Morrison Manufacturing Company.

Two elevator bucket coal conveyors and four suspended roller-flight coal conveyors. Capacity 150 tons per hour. Driven by 50 and 20-horsepower motors. Link-Belt Company.

Vacuum ash-removal system. Exhauster set of positive blowing type; capacity 550 pounds per minute; driven by 100-horsepower motor. Guarantee Construction Company.





Turbine-Room Equipment.

One 35,000-kilowatt turbogenerator. Curtis horizontal 13-stage steam turbine, 1200 revolutions per minute, direct-connected to three-phase, 60-cycle, 13,200-volt generator with direct-driven 150-kilowatt, 250-volt exciter. General Electric Company.

One 30,000-kilowatt turbogenerator. Curtis horizontal 12-stage steam turbine, 1500 revolutions per minute, direct-connected to three-phase, 25-cycle, 13,200-volt generator with direct-driven, 110-kilowatt, 250-volt exciter. General Electric Company.

Two generator-ventilating sets. Induced draft taken through water-spray air washers. Capacity 85,000 and 60,000 cubic feet washed air per minute. Spray Engineering Company.

Two surface condensers. Two-pass radial-flow type. Condensing surface 50,000 square feet each. 10,608 one-inch brass tubes. Westinghouse Machine Company.

Five circulating pumps (two for each condenser and one spare). Tri-rotor centrifugal type. Capacity 37,500 gallons per minute. Each driven through reduction gears by 328-horsepower single-stage steam turbine. Westinghouse Machine Company.

Four condensate pumps (two for each condenser). Single-stage centrifugal type. Capacity 1500 gallons per minute. Each direct-driven by 57-horsepower single-stage steam turbine. Westinghouse Machine Company.

Four air pumps (two for each condenser). Westinghouse-LeBlanc type. Each direct-driven by 100-horsepower steam turbine. Westinghouse Machine Company.

Six revolving screens in water intake basin. Individually driven through reduction gears by 5-horsepower motor. Screens cleaned by water jets supplied by two-stage centrifugal pump direct-connected to 50-horsepower motor. Link-Belt Company.

Buffalo General Electric Company

NIAGARA RIVER STATION.

Located between Niagara River and Erie Canal at Tonawanda, seven miles north of Buffalo. Construction begun January, 1916; first unit in service November, 1916. Three 20,000-kilowatt units now in operation. Work now under way on fourth (35,000-kilowatt) unit. Ultimate total capacity 200,000 kilowatts. Data relate to equipment in service.

Boiler-Room Equipment.

Five water-tube boilers. Cross-drum, double-ended type. Rating, 1140 horsepower. Working pressure, 275 pounds. Superheat, 275 degrees Fahrenheit. Babcock & Wilcox Company.

Ten stokers (one under each end of each boiler). Riley automatic underfeed type. Thirty retorts per boiler. Sanford Riley Stoker Company. Each stoker driven by 5x6-inch 25-horsepower throttling Sturtevant steam engine.

Three forced-draft blowers. Green radial-flow type. Capacity, 210,000 cubic feet per minute. Green Fuel Economizer Company. Direct-driven by steam turbine. Terry Steam Turbine Company.

Five induced-draft fans. Niagara conoidal type. Direct-connected to 130-horsepower variable-speed motor. Buffalo Forge Company.

Five economizers. Heating surface, 9435 square feet. Raise feed-water temperature to 270 degrees Fahrenheit. Green Fuel Economizer Company.

Three feed-water heaters. Cochrane open horizontal type. Rating, 10,000 horsepower. Harrison Safety Boiler Works.

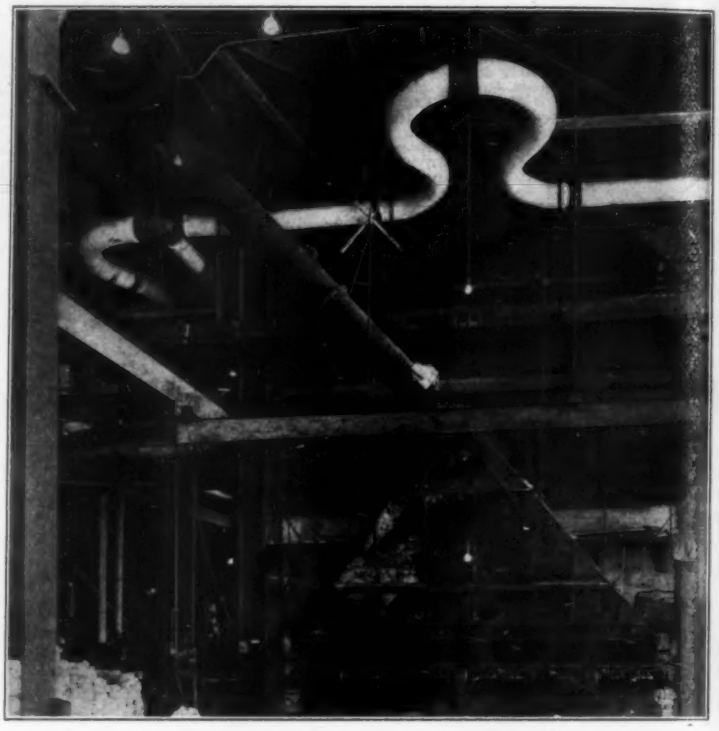
Three boiler-feed pumps. Jeanesville three-stage centrifugal type. Capacity, 1000 gallons per minute. Direct-driven by Westinghouse steam turbines. Jeanesville Iron Works.

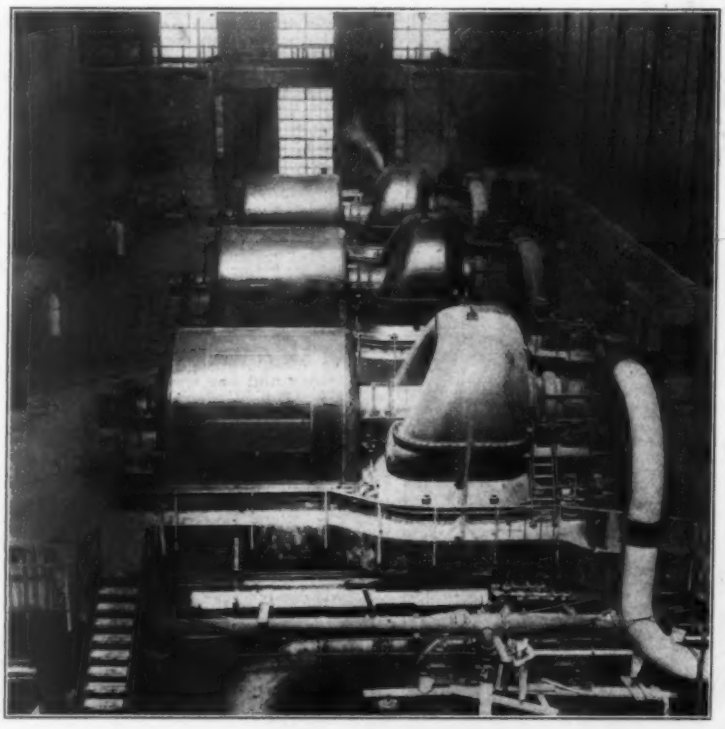
Three evaporators for make-up water. Griscom-Russell two-effect type. Capacity, 10,000 pounds distilled water per hour. Griscom-Russell Company.

Coal-handling machinery. Two coal crushers, two bucket elevators, two belt conveyors. Each set motor-driven. Capacity of each set, 200 tons per hour. Mead-Morrison Manufacturing Company.

Soot cleaners. Vulcan Soot Cleaner Company.

Soot conveyor system. American Steam Conveyor Corporation.





Turbine-Room Equipment.

Three turbogenerators. Curtis horizontal steam turbine. Three-phase, 25-cycle, 12,000-volt, 20,000-kilowatt generator. General Electric Company.

Three surface condensers. Condensing surface, 33,000 square feet. Westinghouse Electric & Manufacturing Company.

Six circulating pumps (two per condenser). Capacity, 25,000 gallons per minute. Driven through reduction gearing by noncondensing steam turbine. Westinghouse Electric & Manufacturing Company.

Six condensate pumps (two per condenser). Horizontal, two-stage centrifugal type. Each direct-connected to noncondensing steam turbine. Westinghouse Electric & Manufacturing Company.

Six air pumps. Westinghouse-LeBlanc type. Driven in pairs by noncondensing steam turbine. Westinghouse Electric & Manufacturing Company.

Turbine-lubrication and oil-filtration system. Richardson-Phenix Company.

Three duplex exciter sets. Each consisting of exciter generator (300 kilowatts), induction motor and steam turbine, and arranged for automatic shift from motor to turbine drive. Terry Steam Turbine Company.

Electric traveling crane. Morgan four-motor type. Capacity, 100 tons. Span, 73 feet. Morgan Engineering Company.

Detroit Edison Company

CONNORS CREEK STATION.

Located on Detroit River at Connors Creek in northeastern part of Detroit, Mich. Built in 1914-15. Designed for total of six units. Three now in service, data for which are given below. Fourth unit being added.

Boiler-Room Equipment.

Six water-tube double-ended boilers. Stirling type W. Rating, 2365 horsepower. Pressure, 225 pounds. Superheat, 200 degrees Fahrenheit. Superheating surface, 2400 square feet. Babcock & Wilcox Company.

Twelve underfeed stokers. One stoker with sloping firebed at each end of boiler; 13 retorts at each end. Operated by variable-speed direct-current motors. American Engineering Company.

Nine forced-draft blowers (three blowers for each pair of boilers). Double conoidal type. Capacity, 74,000 cubic feet air per minute. Driven by variable-speed direct-current motors. Buffalo Forge Company.

Six soot blowers. Diamond Power Specialty Company.

Soot conveyor system. American Steam Conveyor Corporation.

Four boiler-feed pumps. Jeanesville four-stage, double-suction, centrifugal type. Driven by 350-horsepower steam turbines. Speed, 2000 revolutions per minute. Jeanesville Iron Works.

Three coal crushers. Four-roll type. Capacity, 120 tons per hour. Driven by induction motor. Orton & Steinbrenner.

Three flight coal conveyors. Pan type. Capacity, 120 tons per hour. Driven by direct-current motor. Link-Belt Company.

Three coal conveyors. Overlapping-bucket, constant-speed, endless type. Capacity, 120 tons per hour. Driven by induction motor. Link-Belt Company.

Turbine-Room Equipment.

Three turbogenerators. Curtis horizontal nine-stage steam turbines. Three-phase, 60-cycle, 4800-volt generators. Rating, 25,000 kilovolt-amperes. Speed, 1200 revolutions per minute. Direct-connected, 250-volt exciter. General Electric Company.

Three surface condensers. Condensing surface, 35,000 square feet. Henry R. Worthington.

Three circulating pumps. Single-impeller, double-suction volute type. Capacity, 40,000 gallons per minute. Direct-driven by slip-ring induction motor. Henry R. Worthington.

Three air pumps. Rotative two-stage type. Size, 35x30-inch. Driven by variable-speed, direct-current motor. Laidlow-Dunn-Gordon Company.

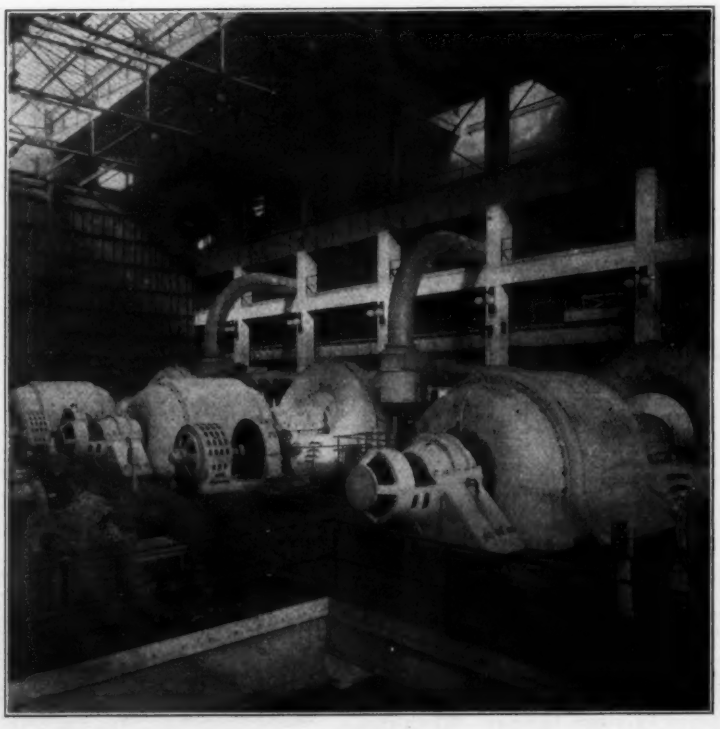
Six condensate pumps (two per condenser). Two-stage centrifugal type. Capacity, 700 gallons per minute. Driven at 1200 revolutions per minute by electric motor. Henry R. Worthington.

Three house-service turbo-alternators. Curtis horizontal steam turbines. Generator rating, 1000 kilowatts, three-phase, 60 cycles, 250 volts. General Electric Company.

Three barometric condensers (one for each house-service turbo-alternator). Size, 20-inch. Alberger Pump & Condenser Company.

Three barometric injection pumps. Single-stage, 4-inch volute type. Alberger Pump & Condenser Company.

One traveling crane. Capacity, 100 tons. Span, 75 feet, 6 inches. Driven by induction motors. Northern Engineering Works.



Commonwealth Edison Company

NORTHWEST STATION.

Located close to North Branch of Chicago River at Roscoe Street, Chicago. First section of station erected 1911-12 with two vertical units; 30,000-kilowatt horizontal unit added in 1915; 30,000-kilowatt horizontal unit added in 1917. Another 30,000 and one 35,000-kilowatt horizontal unit now being added, completing this station.

Boiler-Room Equipment.

Twenty water-tube boilers. Rating 580 horsepower. Pressure 250 pounds. Superheat 125 degrees. Superheating surface 350 square feet. Babcock & Wilcox Company.

Ten water-tube double boilers. B. & W. cross-drum type. Rating 1220 horsepower. Pressure 250 pounds. Superheat 200 degrees. Babcock & Wilcox Company.

Forty chain-grate stokers. Twenty of 115 square feet grate area; 20 of 135 square feet. Babcock & Wilcox Company.

Ten economizers. Heating surface, half of 6566 and half of 7300 square feet. B. F. Sturtevant Company.

Ten induced-draft fans. Capacity 90,000 cubic feet per minute. Driven by 100-horsepower induction motors. B. F. Sturtevant Company.

Four boiler-feed pumps. Three-stage, five-inch Worthington centrifugal type. Capacity 700 gallons per minute. Driven by Curtis steam turbines. Henry R. Worthington.

Two boiler-feed pumps. Three-stage, six-inch Worthington double-impeller type. Driven by Curtis steam turbines. Henry R. Worthington.

Two boiler-feed pumps. Three-stage volute Worthington type. Driven by Westinghouse steam turbines. Worthington Pump & Machinery Corporation.

Four closed feed-water heaters. Warren Webster & Company.

Feed-water regulators. The S-C Regulator Company.

Turbine-Room Equipment.

Two vertical turbogenerators. Curtis six-stage turbine. Three-phase, 25-cycle, 4500-volt, 20,000-kilowatt generator, with autotransformer stepping up to 9000 volts. Speed 750 revolutions per minute. General Electric Company.

One horizontal turbogenerator. Curtis 12-stage turbine. Three-phase 25-cycle, 9000-volt, 30,000-kilowatt generator with direct-connected 110-kilowatt exciter. Speed 1500 revolutions per minute. General Electric Company.

One horizontal turbogenerator. Westinghouse 30,000-kilowatt turbine. Three-phase, 60-cycle, 12,000-volt, 35,300 kilovolt-ampere generator with 160-kilowatt direct-connected exciter. Westinghouse Electric & Manufacturing Company.

Two surface condensers. Condensing surface 32,000 square feet. Henry R. Worthington.

Condenser auxiliaries for above. Two volute circulating pumps 40,000 gallons per minute; two piston-type dry vacuum pumps; driven by Corliss engines. Two two-stage centrifugal condensate pumps driven by steam turbines. Henry R. Worthington.

One surface condenser. Condensing surface 50,000 square feet. Wheeler two-pass type. C. H. Wheeler Manufacturing Company.

Condenser auxiliaries for above. One 48-inch double-suction centrifugal circulating pump, capacity 52,000 gallons per minute. Combination condensate and "hurling-water" air pump. All driven by 650-horsepower Curtis steam turbine. C. H. Wheeler Manufacturing Company.

Two surface condensers forming double unit. Total condensing surface 56,000 square feet. Westinghouse Machine Company.

Condenser auxiliaries for above. Centrifugal circulating pump, motor-driven. Two centrifugal condensate pumps and two Westinghouse-LeBlanc air pumps, driven by steam turbines. Westinghouse Electric & Manufacturing Company.

Public Service Electric Company

ESSEX STATION.

Located at Point-No-Point on Passaic River, about 2.5 miles east of Newark, N. J. Construction began July, 1914; first unit in operation, October, 1915. Data below on two units now in service. Third (35,000-kilowatt) unit now being added. Station designed for six units.

Boiler-Room Equipment.

Eight water-tube boilers. Cross-drum type. Rating, 1373 horsepower. Pressure, 225 pounds. Superheat, 100 degrees Fahrenheit. Steam drum, 60 inches diameter. Superheating surface, 1711 square feet. Babcock & Wilcox Company.

Eight Riley underfeed stokers. Sixteen retorts per boiler. Rated feed up to 15,000 pounds coal per hour. Each stoker driven by 12-horsepower four-speed induction motor, either through jackshaft or Reeves multiple-speed transmission. Sanford Riley Stoker Company.

Eight forced-draft blowers. Turbovane type. Capacity, 60,000 cubic feet air per minute. Driven by 150-horsepower two-speed induction motor. B. F. Sturtevant Company.

Eight induced-draft fans. Multivane type. Capacity, 106,000 cubic feet gas per minute. Each driven by 100-horsepower induction motor. B. F. Sturtevant Company.

Eight economizers. Multipass type, 480 tubes. Heating surface, 7750 square feet. B. F. Sturtevant Company.

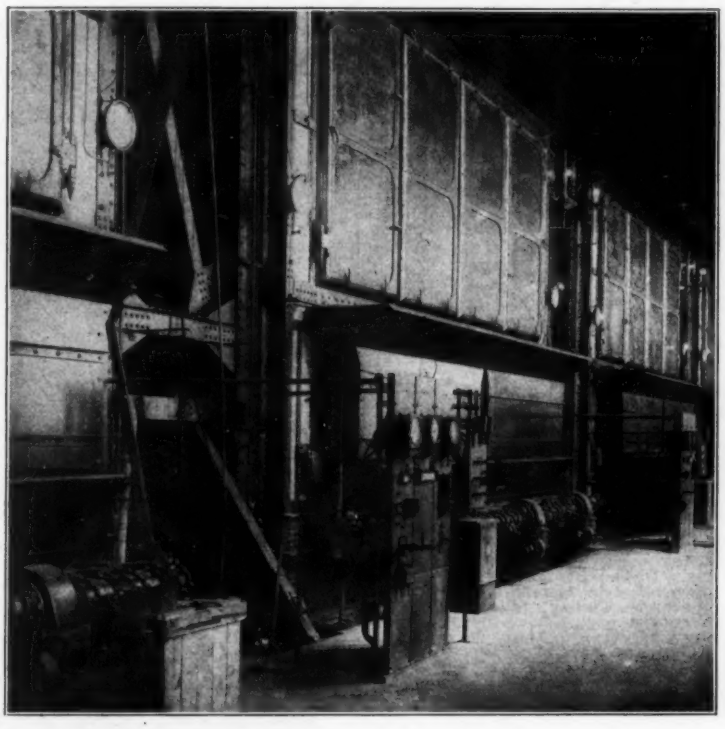
Two Cochrane metering open feed-water heaters. Capacity, 500,000 pounds water per hour. Harrison Safety Boiler Works.

Three boiler-feed pumps. Three-stage, double-suction type. Capacity, 1000 gallons per minute. Direct-driven by 250-horsepower Westinghouse steam turbines. International Steam Pump Company.

One coal hoist and one traversing engine. Capacity, 240 tons per hour. Driven by 110 and 75-horsepower induction motors. Maine Electric Company.

Two coal belt conveyors. Capacity, 300 and 200 tons per hour. Driven by 20 and 10-horsepower induction motors. Robins Conveying Belt Company.

Two coal larries. Automatic weighing type. Capacity, 15 tons. Driven by 11-horsepower Westinghouse motor. Robins Conveying Belt Company.



Turbine-Room Equipment.

Two turbogenerators. Curtis 12-stage, 25,000-kilowatt steam turbines. Three-phase, 60-cycle, 25,000-kilovolt-ampere, 13,200-volt generators with 100-kilowatt, 250-volt, direct-connected exciters. Speed, 1800 revolutions per minute. General Electric Company.

Two surface condensers. Two-pass Westinghouse type. Condensing surface, 32,000 square feet. Westinghouse Machine Company.

Four circulating pumps (two for each condenser). Horizontal double-suction volute type. Capacity, 24,000 gallons per minute. One pump in each set driven by 350-horsepower steam turbine through reduction gearing, other driven by 350-horsepower induction motor. Westinghouse Electric & Manufacturing Company.

Two air pumps. Westinghouse-Le-Blanc type. Capacity, 37.5 cubic feet free air per minute. Each direct-driven by 100-horsepower induction motor. Westinghouse Electric & Manufacturing Company.

Two condensate pumps. Centrifugal type. Size, 8-inch; capacity, 500 gallons per minute. Driven by 20-horsepower steam turbines. Westinghouse Machine Company.

Two generator-ventilating sets with air washers. Capacity, 60,000 cubic feet air per minute. Ten-horsepower motor-driven pumps for spray air washers. Spray Engineering Company.

One reserve exciter. Rating, 150 kilowatts, 250 volts. Direct-driven by 220-horsepower induction motor, 1175 revolutions per minute. Allis-Chalmers Manufacturing Company.

One electric traveling crane. Rating, 100 tons. Span, 94 feet. Two 50-ton and one 10-ton hooks. Morgan Engineering Company.

United Electric Light & Power Company

201ST STREET STATION.

Located at 201st Street on Harlem River and Sherman Creek, New York City. Supplies 60-cycle alternating current only to Borough of Manhattan and northern part of city. Erected in 1913 and placed in operation in January, 1914.

Boiler-Room Equipment.

Thirty-two water-tube boilers. Rating, 650 horsepower. Pressure, 200 pounds. Superheat, 125 degrees Fahrenheit. Superheating surface, 750 square feet. Babcock & Wilcox Company.

Taylor underfeed stokers. Driven in groups of four by 30-horsepower induction motors with Reeves variable-speed cone transmission. American Engineering Company.

Four sets of forced-draft blowers, each with three fans, one of which is in reserve. Two fans of each set have capacity of 80,000 cubic feet of air per minute. Each blower set supplies air for eight boilers and is driven through gearing by a steam turbine. B. F. Sturtevant Company.

Sixteen cinder and soot catchers in smoke flues (one for each two boilers). Metropolitan Engineering Company.

Two Cochrane feed-water heaters with Lea V-notch recording meters. Harrison Safety Boiler Works.

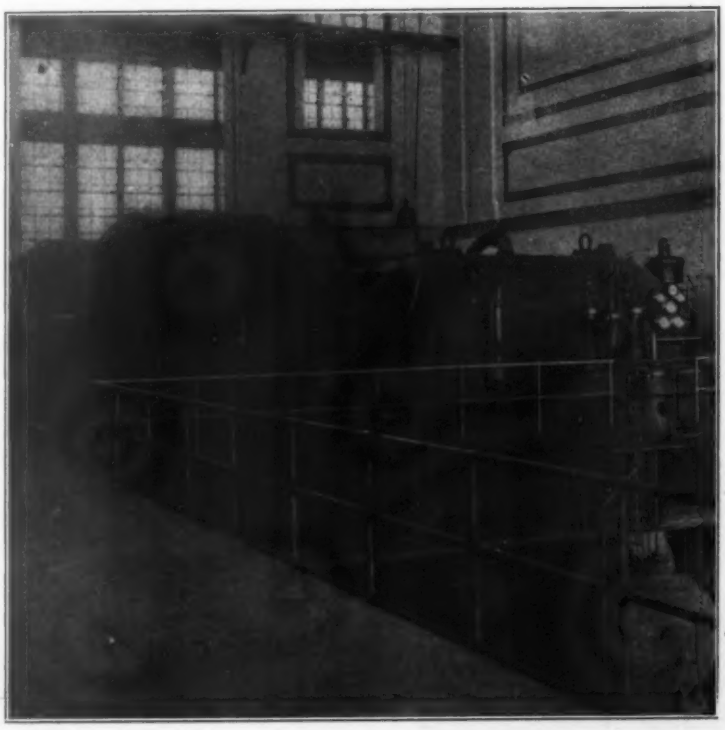
Three boiler-feed pumps. Centrifugal types. Driven by steam turbines.

Feed-water regulation. The S-C Regulator Company.

Two coal hoists. Hoisting from river barges to top of coal tower; 1½-ton grab bucket each. Capacity, 300 tons per hour. Driven by steam engine.

Two electric locomotives for hauling ash cars. Trolley type, 220 volts, 10 horsepower each. General Electric Company.

Thirty-two soot cleaners. Vulcan Soot Cleaner Company.



Turbine-Room Equipment.

Three turbogenerators. Westinghouse horizontal double-flow turbines; rating, 22,500 brake horsepower. Three-phase, 60-cycle generators; rating, 19,000 kilovolt-amperes, 7500 volts. Speed, 1875 revolutions per minute. Westinghouse Electric & Manufacturing Company.

Three surface condensers. Westinghouse two-pass type. Cooling surface, 20,000 square feet. Westinghouse Machine Company.

Three circulating pumps. Westinghouse-LeBlanc centrifugal type. Capacity, 24,000 gallons per minute. Driven through reduction gears by steam turbine. Westinghouse Machine Company.

Three hot-well pumps. Horizontal single-stage, double-suction centrifugal type. Direct-driven by 15-horsepower steam turbines. Westinghouse Machine Company.

Three air pumps. Rotary turbine type. Speed, 3500 revolutions per minute. Direct-driven by 75-horsepower steam turbine. Westinghouse Machine Company.

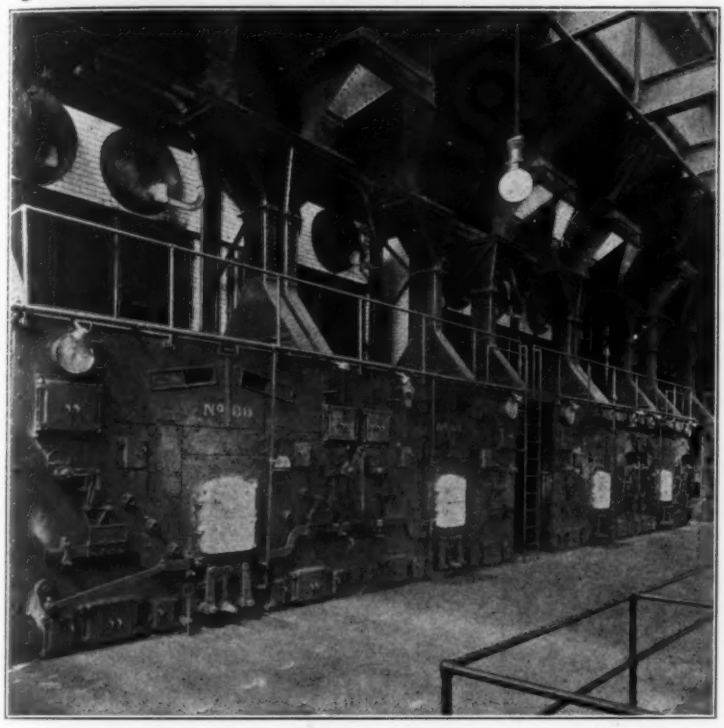
Three generator-ventilating sets. Blower of each set has 110-horsepower induction motor on each end of shaft, one being reserve.

Three exciter sets. Exciter generator capacity, 200 kilowatts, 250 to 350 volts. Direct-driven by 7500-volt, three-phase induction motor.

Edison Electric Illuminating Co. of Boston

L STREET STATION.

Located at L Street in South Boston, on Boston Harbor. Consists of two sections, the older one built about 20 years ago and containing engine-driven generators. Newer section built and enlarged during last 13 years contains eight vertical tubogenerators, data on which follow. New 30,000-kilowatt horizontal unit now being installed in an extension of station.



Boiler-Room Equipment.

Forty-eight water-tube boilers. Rating, 512 horsepower. Pressure, 200 pounds. Superheat, 150 degrees Fahrenheit. Superheating surface, 867 square feet. Babcock & Wilcox Company.

Forty Murphy sidefeed stokers. Driven by noncondensing steam engines. Murphy Iron Works.

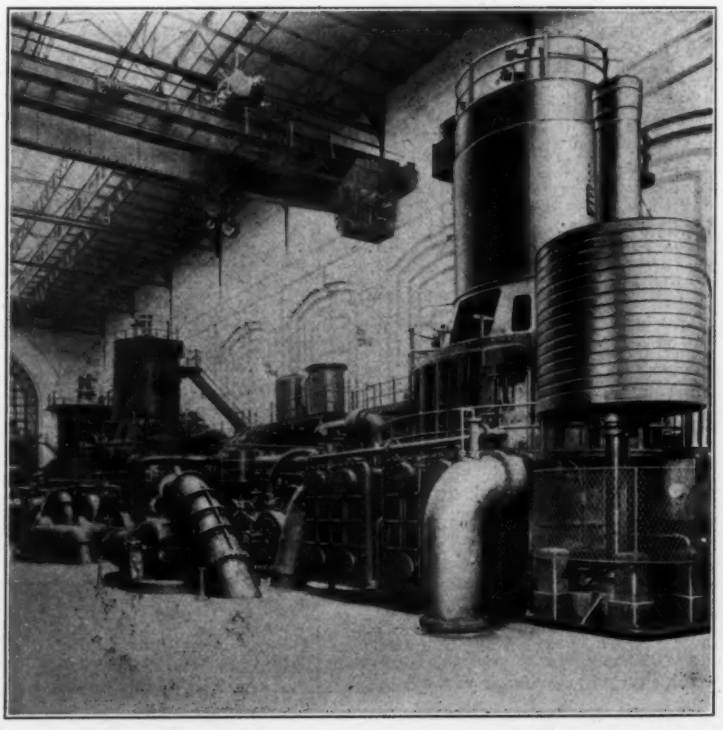
Eight Roney automatic stokers. Driven by electric motors. Westinghouse Machine Company.

Draft system. Blaisdell-Canady balanced-draft with Argand forced-draft blowers.

Eight feed-water heaters. Seven closed and one open type. National Pipe Bending Company.

Feed-water treatment. Dearborn Chemical Company's system.

Ten coal conveyors. Robins Conveying Belt Company.



Turbine-Room Equipment.

Two turbogenerators. Curtis vertical turbine. Three-phase, 60-cycle, 6900-volt, 7500-kilowatt generators. General Electric Company.

Three turbogenerators. Curtis vertical turbine. Three-phase, 60-cycle, 6900-volt, 12,000-kilowatt generator. General Electric Company.

Three turbogenerators. Curtis vertical turbine. Three-phase, 60-cycle, 6900-volt, 15,000-kilowatt generator. General Electric Company.

Eight surface condensers. Condensing surface: three of 20,000 square feet, two of 25,000 square feet, one of 27,870 square feet. Henry R. Worthington.

Circulating pumps. Worthington volute centrifugal type. Capacities up to 50,000 gallons per minute. Partly driven by engines and partly by motors. Henry R. Worthington.

Eight condensate pumps. Centrifugal type. Partly motor and partly turbine-driven. Henry R. Worthington.

Five dry vacuum pumps. Worthington angle type. Steam-driven. Henry R. Worthington.

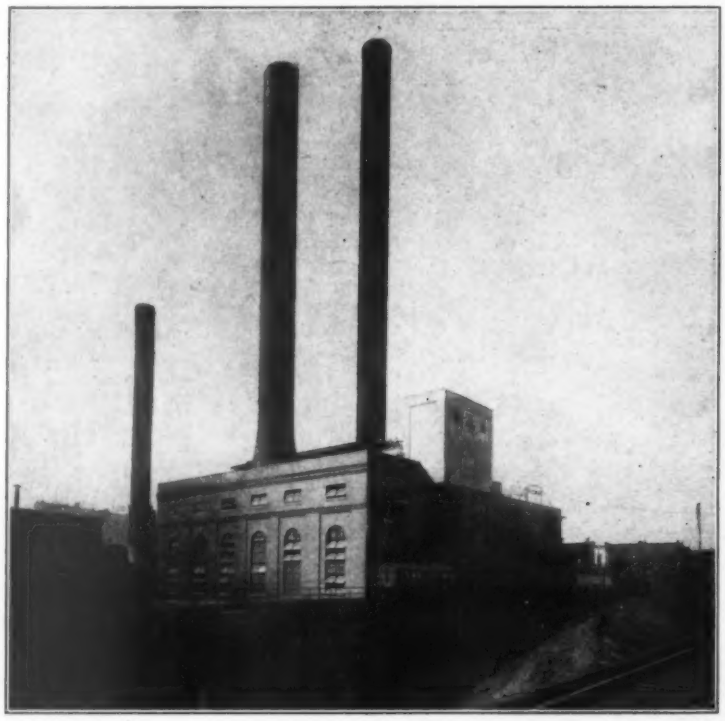
Three dry vacuum pumps. Laidlaw-Dunn-Gordon Company angle type, steam-driven.

Three exciter sets. Three-phase, 445-horsepower synchronous motors. 125-volt exciters. General Electric Company.

Louisville Gas & Electric Company

WATERSIDE STATION.

Located on Ohio River in Louisville, Ky. Erected about 1910 with two turbogenerators of 2000 and 4000 kilowatts capacity. Three larger units have been added in the last three years. Present installed capacity is 32,500 kilowatts.



Boiler-Room Equipment.

Sixteen water-tube boilers. Twelve 500 horsepower each; four 880 horsepower each. Pressure, 185 and 200 pounds. Superheat, 125 degrees Fahrenheit. Babcock & Wilcox Company.

Twelve B. & W. chain-grate stokers. Two engine and two motor drives. Babcock & Wilcox Company.

Four Westinghouse underfeed stokers. Two engine drives. Westinghouse Machine Company.

Three forced-draft blowers. Conoidal type. Driven by steam turbines through reduction gears. Buffalo Forge Company.

Five boiler-feed pumps. Jeanesville centrifugal type. Driven by steam turbines. Jeanesville Iron Works.

Three feed-water heaters. Two open and one closed type. Platt Iron Works Company.

Coal and ash-handling equipment. Bucket elevators and belt conveyors. Robins Conveying Belt Company.

Two feed-water recorders. Lea V-notch type. Yarnall-Waring Company.

Sixteen soot cleaners. Vulcan Soot Cleaner Company.

Turbine-Room Equipment.

One turbogenerator. Curtis horizontal turbine. Three-phase, 60-cycle, 2300-4600-volt, 2000-kilowatt generator. Speed, 1800 revolutions per minute. General Electric Company.

One turbogenerator. Curtis horizontal turbine. Three-phase, 60-cycle, 2300-4600-volt, 4000-kilowatt generator. Speed, 1800 revolutions per minute. General Electric Company.

One turbogenerator. Curtis horizontal turbine. Three-phase, 60-cycle, 2300-volt, 5000-kilowatt generator. General Electric Company.

One turbogenerator. Curtis horizontal turbine. Three-phase, 60-cycle, 2300-volt, 6500-kilowatt generator. General Electric Company.

One turbogenerator. Curtis horizontal turbine. Three-phase, 60-cycle, 6600-13,200-volt, 15,000-kilowatt generator. General Electric Company.

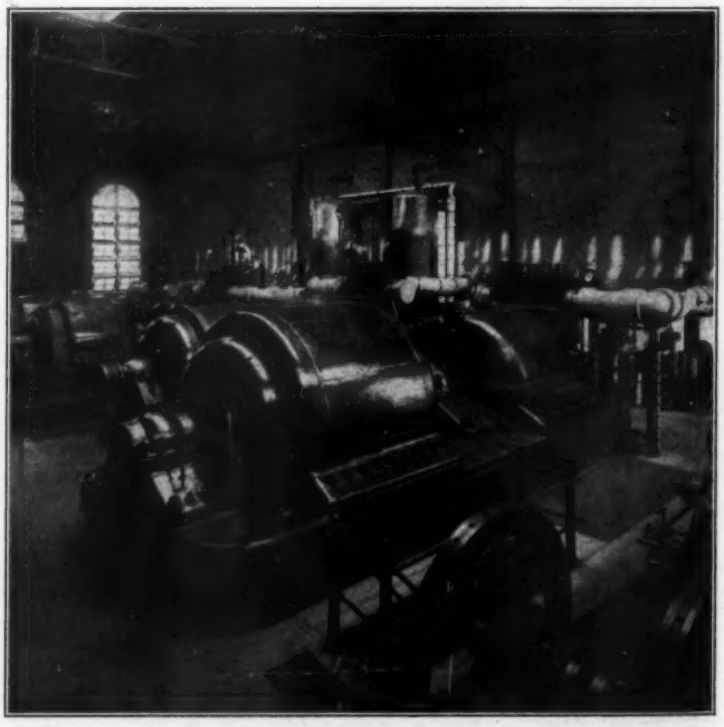
Two surface condensers. Condensing surface, 10,000 square feet each. Alberger Pump & Condenser Company.

Condenser auxiliaries for above. Two tri-rotor circulating pumps and two two-stage hot-well pumps driven on same shaft by steam turbines. Two dry vacuum pumps, steam-driven. Alberger Pump & Condenser Company.

Three surface condensers for larger turbines. Henry R. Worthington.

Condenser auxiliaries for above. Partly steam and partly motor-driven. All Henry R. Worthington type.

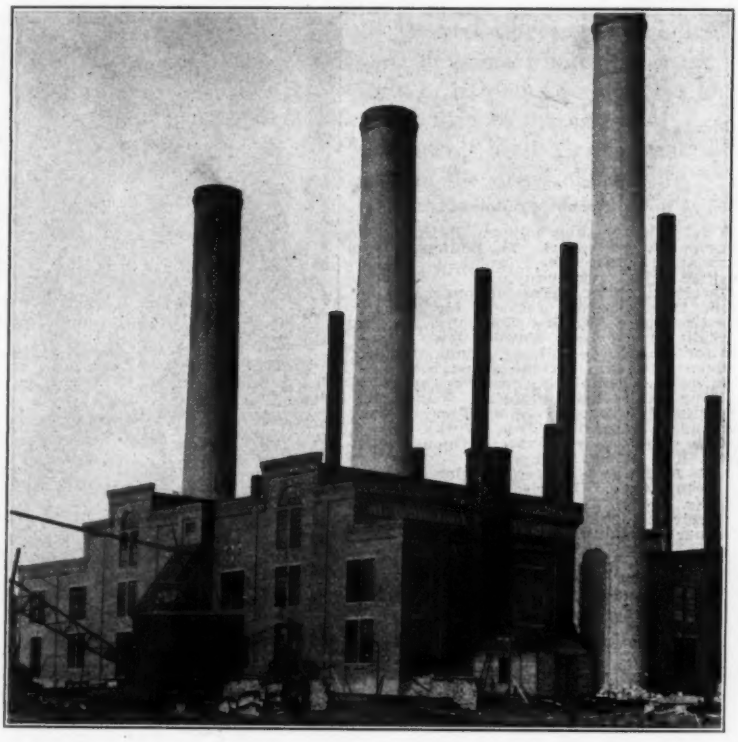
Two air-washing equipments for generator ventilation. Spray Engineering Company.



Duquesne Light Company

BRUNOTS ISLAND STATION.

Located on Brunots Island, Pittsburgh, Pa., between two channels of the Ohio River. Originally built for 10 cross-compound engine-driven 1500-kilowatt units. These are being replaced from year to year by horizontal turbogenerators, of which one 3000, one 5000 and five 15,300-kilowatt units are now in service. Data below relate principally to latter. A 40,000-kilowatt cross-compound turbo unit is now being added.



Boiler-Room Equipment.

Forty-nine water-tube boilers, as follows: 20 823-horsepower class M Stirling; 10 600-horsepower B. & W.; 19 500-horsepower B. & W. Pressure, 200 pounds. Superheat, 125 degrees Fahrenheit. Babcock & Wilcox Company.

Forty-nine automatic stokers, as follows: 20 type L chain-grate type, Green Engineering Company; 19 Murphy type, Murphy Iron Works; 8 Roney type, Westinghouse Machine Company; two Westinghouse underfeed type, Westinghouse Machine Company.

Boiler feed pumps. Worthington centrifugal type. Capacity, 2000 gallons per minute. Driven by Westinghouse high-speed steam turbines. Henry R. Worthington.

Coal-handling equipment. Electrically operated coal hoist at dock, with 4-ton grab bucket; capacity, 200 tons per hour. Larry car 14-ton size. Electric locomotive coal crane; capacity, 200 tons per hour. Three coal conveyors.

Twenty-four soot cleaners. Vulcan Soot Cleaner Company.

Turbine-Room Equipment.

Five turbogenerators. Westinghouse-Parsons double-flow, impulse and reaction turbine. Three-phase, 60-cycle, 12,000-volt, 15,300-kilowatt generator. Speed, 1800 revolutions per minute. Westinghouse Electric & Manufacturing Company.

One turbogenerator. Westinghouse-Parsons turbine. Three-phase, 60-cycle, 12,000-volt, 5000-kilowatt generator. Westinghouse Electric & Manufacturing Company.

One turbogenerator. Westinghouse-Parsons turbine. Three-phase, 60-cycle, 12,000-volt, 3000-kilowatt generator. Westinghouse Electric & Manufacturing Company.

Surface condensers. Worthington duplex type. Henry R. Worthington.

Circulating pumps (two for each large condenser). Henry R. Worthington.

Generator ventilating system. American Sirocco blowers driven by Westinghouse induction motors.

Air washer for ventilating system. Spray nozzles supplied through motor-driven circulating pump. Spray Engineering Company.

Four exciter sets, as follows: one 250-kilowatt motor-driven exciter. Westinghouse Electric & Manufacturing Company. Two 150-kilowatt steam-turbine-driven exciters. Westinghouse Electric & Manufacturing Company. One 150-kilowatt steam-turbine-driven exciter. General Electric Company.

Minneapolis General Electric Company

RIVERSIDE STATION.

Located on Mississippi River in Minneapolis, Minn. Operated as steam auxiliary to extensive hydroelectric system by supplying peak-load and emergency service. Three turbogenerators run part time as synchronous motors for system regulation and readiness for instant generation. Will soon add 25,000-kilowatt turbo unit.

Boiler-Room Equipment.

Twelve water-tube boilers. Rating, 600 horsepower. Pressure, 200 pounds. Superheat, 125 degrees Fahrenheit. Babcock & Wilcox Company.

Twelve stokers. Westinghouse underfeed type. Seven retorts for boiler. Westinghouse Machine Company.

Eight forced-draft blowers (two blowers for each three boilers). Conoidal type. Driven by steam turbine through reduction gears. Buffalo Forge Company.

Four boiler-feed pumps. Jeanesville centrifugal type. Driven by Terry steam turbines. Jeanesville Iron Works.

One feed-water heater. Open type. Platt Iron Works Company.

One feed-water heater. Cochrane open metering type. Harrison Safety Boiler Works.

Twelve soot cleaners. Vulcan Soot Cleaner Company.

Turbine-Room Equipment.

Two turbogenerators. Horizontal turbine. Three-phase, 60-cycle, 2300-volt. 6000-kilowatt generator. Allis-Chalmers Manufacturing Company.

One turbogenerator. Curtis horizontal turbine. Three-phase, 60-cycle, 13,200-volt, 15,000-kilowatt generator. General Electric Company.

Two surface condensers. Condensing surface, 12,500 square feet each. C. H. Wheeler Manufacturing Company.

Condenser auxiliary pumps for above. All steam-driven. C. H. Wheeler Manufacturing Company.

One surface condenser. Condensing surface, 27,500 square feet. Henry R. Worthington.

Circulating and condensate pumps for above. Motor-driven. Henry R. Worthington.

Vacuum pump for large condenser. Two-stage, centrifugal type. Steam-turbine-driven. Henry R. Worthington.

Three air-washing equipments for generator ventilation. Spray Engineering Company.

Editorial Comment

Effect of Export Problems on American Manufacturers

RECENT revelations affecting Sweden show that the problem of controlling exports so as to shut off the stream of supplies reaching Germany through neutral countries is one of the knottiest the Administration has to solve, as well as one of the most important. Shortening the war means the saving of many American lives, and as a means to this end the regulation of shipments abroad is vital.

Rigid enforcement of the rules of the Exports Board is likely to encounter strong opposition from business interests directly affected and from sentimentalists. Lack of public information as to just how valuable the aid of neighboring neutrals has been to Germany gives opportunity for this opposition to work with a freer hand than would be the case if all the facts were known.

For these reasons a report on this subject by James Louis Moore, fellow of Harvard University for European Research in Modern History and International Law, is of timely interest. Mr. Moore collected his data from official records in Berne, Switzerland, where he spent nearly a year in the work.

In a review of this report, *Commerce and Finance* refers to figures given by Mr. Moore on imports and exports of a multitude of articles from 1913 down to the present time. To ascertain the full amount of aid received by the central empires the figures he furnished must be multiplied by five, he says, and even then, he declares, they would be conservative, for the great probability, if not certainty, exists that Holland, Sweden and Denmark each exported more foodstuffs to Germany in 1915 and 1916 than Switzerland, and in the case of Sweden this was certainly supplemented by a great amount of metals, domestic and imported from America, the latter having been exported to Germany contrary to agreement with the British Government.

That this aid is precious to the central powers and has enabled them to stave off submission can be corroborated in various ways. In spite of the enormous volume of imports from neutrals, the economic crisis coincided with the political crisis in the Reichstag at the beginning of July. The most potent cause of this political upheaval was the economic destitution, which cast its melancholy shadow over the whole German nation and increased the desperation of people and Reichstag till it exploded in a violent outburst of wrath against the government.

Copper deserves serious attention and a comparison of only one port of entry is significant. In 1915 Switzerland exported a grand total of 7,615,740 pounds of old copper, all of which the central empires, principally Germany, received—this against an importation from the same country in 1913. New copper in the form of bars, ingots, etc., was imported into Switzerland in 1913 to the extent of 10,146,400 pounds, the chief sources being Germany, France and the United States, in the order named. In 1915 the import rose slightly to 11,061,660 pounds, more than half of which came from the United States. But in 1916 the increase is more than threefold greater than in 1913, amounting to the surprising figure of 32,536,240 pounds, of which 21,942,360 pounds came from the United States.

Why has the import of copper in 1916 increased more than 200 per cent over 1913? Has Switzerland's own legitimate need of this metal risen in this suspicious ratio? No greatly accelerated electrification of Swiss steam roads or industry during the war would require such increased supply of copper wire. The figures give no indication of an export of raw copper, but we know that copper has been reaching Germany in sufficient quantities to keep her going.

Contesting Commission Decisions

THE progress made in the last ten years in the establishment of public utility commissions by the states and in the regulation of utilities by these commissions leaves no doubt that this method of control has come to stay, and that it is generally regarded as the best system for protecting the rights of the consumer, the investor and the operator of the public utility. We may look for further extensions of the authority and jurisdiction of the commissions in those states where their power is as yet quite limited. Every state except Delaware exercises in this way some control over its railroads, and electric utilities can look forward to the universal extension of the method to include themselves.

In meeting the application of this method to their own companies, utility officials will doubtless often feel that commissioners are not fair to them. Occasionally this may actually be the case, as the choice of commissioners is not always well made, and some of them may not be free from partisanship. Usually, however, commissioners aim to treat both sides to a controversy fairly, and apparent unfairness is probably due to a difference of opinion or to a different point of view from that held by the utility official. Co-operation in bringing out full information upon which a fair decision must be based should always be yielded by utility officials and an attitude of frankness

and sincerity and an evident willingness to be fair upon the part of utility officials will go far in promoting a similar attitude upon the part of commissioners. A spirit and evident attitude of antagonism to the commission seldom benefits a utility organization and in some cases engenders an atmosphere that is not conducive to judicial consideration of the merits of the case.

Of course a utility corporation should always present its case in the strongest light possible and should be prepared to back up its claims with facts and figures. Having presented its case fully and effectively it should accept the resulting decision with good grace, unless indeed the decision appears to actually infringe its rights and to be unjust to the extent of being without the pale of law. Occasionally commission decisions are in the latter class, and appeal to the courts is necessary to secure justice, but such appeals are often made without sufficient warrant. It should be realized that in matters of opinion the decision of utility commission can not, in most states, be upset, and unless the decision of some important fact, such as the value of the property used in the public service, can be upset, reversal of a decision will only be made upon some point of law in which the commission was in error. The Supreme Court of Wisconsin well stated this attitude of the courts in a case in 1908, declaring that even though on the given facts the court might decide a case differently from the commission, if no errors of law have been committed and the question is one regarding which reasonable and competent men might differ, the court will not set aside the order of the commission. A court will not decide, for instance, what is a reasonable rate of return which a utility should be permitted to earn upon the value of its property.

Many cases are appealed to the courts upon constitutional points, the most common being that the federal or state constitution prohibits the taking of private property for public use without compensation. This has usually been interpreted to mean that a utility corporation must not have its rates reduced below a point where it can earn a minimum return upon its investment. Just what the minimum rate of return is has never been fixed and probably never will be for all cases. It is assuredly less than would generally be considered reasonable, and less than any commission would allow in a rate case, since it is generally conceded to be good public policy to allow sufficient return to attract new capital into utility enterprises. Consequently most efforts to upset commission decisions on the claim of confiscation of utility property have failed. This may even apply to slight disagreements as to the value of the utility property, since a higher rate of interest on a low estimate of value may amount to as great a sum of revenue to be allowed as a lower yet permissible rate of return on a higher estimate of value. An example of this is the case of the San Joaquin Light and Power Corporation, which carried a rate decision to the Supreme Court of California, claiming that the valuation of its property made insufficient allowances for water rights and going value. In its decision made last May the Court points out that eight per cent of the commission's valuation was 6.5 per cent of the company's valuation and such a return could not be considered confiscatory. The court did not allow the company's claims for value, but even if it had the decision of the commission would not have been affected. Evidently to contest such decisions is futile.

Scientific Feed-Water Regulation

THE general introduction and high development of the steam turbine and forced-draft stoker, during the past ten years, has given the greatest impetus to steam generation that the world has ever known. One result has been the growth of boiler units up to as high as 2400 horsepower, an increase in combustion rates, and a steady climb in steam pressure.

Man has chained up enormous forces in large units, the control and direction of which have become of paramount importance. Factors which could be disregarded twenty years ago now become vital because of the sheer momentum of the forces involved. In fact, modern operation has become almost entirely one of the scientific control of all the variables entering into steam generation.

New conditions bring new responsibilities and new devices for meeting them. In the very beginning of the steam era we had hand-operated and hand-controlled valves on the steam engine, and one will recall the classic story of the lazy engine boy who tied the valve levers to the flywheel and thus gave the world the first automatic engine. It was naturally but a short step from this to the automatic engine governor, which not only governed the engine but regulated the steam output on the boiler in proportion to the load. Thus was regulation established in the steam cycle, and particularly in the boiler room.

The economy of higher ratings has advanced the cause of efficient and scientific regulation, and the past ten years has seen the development of satisfactory control of air and coal to the boiler. As is pointed out by R. M. Andrews in an article on feed-water regulation in this issue, the study of operation during this period, by means of the increased use of instruments, has also shown the necessity of proper control of the water input and has brought about scientific control of the feed water in relation to the load and furnace conditions.

This is a subject of great importance at this time, but one which is too frequently neglected. The efficient and economical operation of a central-station plant is as dependent on proper water regulation as on any other phase of operation and the data presented by Mr. Andrews should be carefully studied by all engineers.

HAPPENINGS IN THE INDUSTRY

War Problems Discussed by Pennsylvania Association—Iron and Steel Engineers' Convention—Program for National Electrical Contractors' Association Convention at New Orleans

WAR PROBLEMS OF CENTRAL-STATION COMPANIES.

Addresses by J. B. McCall, J. W. Lieb and W. D. B. Ainey Characterize Convention of Pennsylvania Association.

The critical effects of war conditions upon the affairs of electrical utilities in Pennsylvania and means for their partial alleviation were considered by a trinity of leaders in their respective spheres—Joseph B. McCall, president of the Philadelphia Electric Company; John W. Lieb, president of the National Electric Light Association, and Hon. Wm. D. B. Ainey, chairman of the Pennsylvania Public Service Commission—during the convention of the Pennsylvania Electric Association held at Bedford Springs, Pa., on September 7 and 8. The program was deliberately stripped of all non-essential features in order that the available time of the 150 representatives of the member companies present could be applied to the greatest advantage.

In looking back upon his 22 years' connection with the central-station industry, in comparison with the many problems that must now be solved, Mr. McCall gave as his most serious conviction that the industry is at present facing the most serious crisis in its history, and all concerned—employees, stockholders and the public—must be prepared to make supreme sacrifices.

As an indication of the disruption of organization in one case, he showed that in the Philadelphia Electric Company, 200 men have already enlisted and 950 are included in the selective draft, of which 253 have already been called for examination. The turnover of unskilled labor during the past few months has been in the neighborhood of 300 per cent, in spite of the fact that the central-station industry has always been noted for its permanent and satisfied personnel. It has become absolutely necessary to adopt measures of relief, quality and quantity, comparable to the needs of the situation and the importance of reliability of service. This has been done by the employment of women, by shifting the older men from minor to more important duties, and by meeting in part the price paid in other war-stimulated lines of trade, all at an added labor charge of from $300,000 to $400,000 per annum.

In the matter of cost increases of material, the kilowatt-hour coal cost at the busbars is now equal to the total kilowatt-hour busbar cost one year ago. If the opinions of transportation and mining experts can be taken as a criterion, the coal situation will remain acute for some time to come and Mr. McCall advises the greatest possible storage for the needs of the coming year.

Not only has it been extremely difficult to adequately serve both the government and private consumers in Philadelphia with the existing facilities but the state of the investment market has had a very disastrous effect upon new financing for the purpose of providing additional equipment.

Mr. McCall reiterated his unqualified belief in the principle of commission regulation first publicly expressed by him in spite of severe criticism at the time of an N. E. L. A. convention several years ago, by pointing out the duty of regulatory bodies to lift equities upward upon the proper presentation of the facts in each particular case. In normal times, the policy has been for the utilities to divide their savings with their consumers. Now, however, the pendulum must of necessity swing in the opposite direction. The weight of the increases, however, should fall on the larger consumers whose profits have been increased on account of high selling prices rather than on the small domestic customers already badly demoralized by high costs of living and of doing business.

War Conditions Discussed by Mr. Lieb.

While addressing the meeting by virtue of his position as president of the N. E. L. A., Mr. Lieb properly chose to confine his characteristically forceful remarks to a discussion of war conditions in general and incidentally to the work of the National Committee on Gas and Electric Service, of which he is chairman.

The demands of the Government upon the administrative and operating functions of the country have been new, sudden and untried. Due to stringent and sometimes unreasonable regulation, the utility companies have been forced to occupy the space between the upper and nether mill-stones in that they have found themselves lacking in flexibility to respond to the conditions thrust upon them by the war. To relieve this dangerous condition by virtue of relieving the pressure of rising costs, it is absolutely necessary for maintaining the quality of service to ask the regulatory bodies for the unpopular but inevitable increase of rates, not, however, until the public is fully advised of the facts in the case properly presented. In adopting the course of fixing the selling cost of its commodity with due regard to its manufacturing cost, the central stations are merely following the principle of fair prices compatible with good wages and high efficiency laid down by President Wilson in a recent address.

Showing that various interests necessary to the conduct of the war must be considered in connection with the coal problem, Mr. Lieb pointed out that the coal situation is infinitely worse in the allied countries of Europe. The great problem of the governmental agencies has been the question of priority in the coal supply between private and Government demands and between the demands of different industries.

One of the first points of contact with the Government after the organization of the Committee on Gas and Electric Service was consideration of the effect of the selective draft upon central-station service. The Government was originally inclined to interpret the

industrial exemption provisions quite liberally but it has developed that the district boards to whom the power of decision has been given, have been very loath to grant industrial exemptions except in very exceptional cases.

In concluding his very interesting address, Mr. Lieb emphasized his unshaken belief in the fundamental stability of the central-station industry and its ability and willingness to make any sacrifices for the sustenance of the national interest.

W. D. B. Ainey Discusses Attitude of Commissions.

Predicating his statement upon the results of his experience with the central stations as chairman of the Public Service Commission in that the co-operation with the commission shown by them has not been exceeded by any other group of utilities, Mr. Ainey felt positive of their desire to deal reasonably and justly with the public.

After briefly tracing the development of the regulatory idea and the recognition of the monopolistic character of utilities, he showed that increasing costs and fixed revenue make their impress even upon the commission itself. The work of this body is handled by about 110 experts of various kinds on a smaller proportional appropriation than is given to any other similar body in the country in spite of the fact that the business before the commission has increased over 100 per cent during the past year.

In the course of some general observations upon the effect of war conditions on utilities, Mr. Ainey emphasized the enormity of the prodigal energy losses resulting from present methods of using fuel and other materials. Commenting upon the tendency of charging increased rates without due regard, in some cases, to eliminating wasteful and slovenly methods of operation, he predicted a contraction of the market for energy, thus possibly changing its status from a necessity to a luxury as in earlier years. In any event, conditions vary so widely even within adjacent sections that a consideration of the facts in each individual case is absolutely necessary for an intelligent presentation of the situation. With the many adjustments sure to come in the future, Mr. Ainey bespoke the continued co-operation of the utilities.

Address of Mr. Tripp.

In his presidential address, George B. Tripp discussed the localized effects of the war situation and advised individual applications for rate increases rather than a blanket petition for all, and emphasized the need for quick and concerted action. The Pennsylvania Electric Association still retains its lead among all geographic sections with a roll of 94 Class A and 1823 Class B members.

Representing the Accounting Committee, H. R. Kern, Philadelphia, chairman, outlined the progress of negotiations with the Public Service Commission Bureau of Accounts and Statistics with reference to the Classification of Accounts and the Standard Report. The forms tentatively adopted will be released during the latter part of September.

In reporting for the Geographic Sections Committee, chairman A. H. S. Cantlin, Allentown, described the great good resulting from the Sections Idea and warmly recommended its continuance and enlargement. He prophesied the time when the usual large, costly and unwieldy state and national conventions will be replaced by a meeting of representatives of just such sectional bodies.

Henry Harris, Wilmerding, chairman of the Committee on Rates, discussed the position of that committee in the matter of cash deposits and stated that a draft of its recommendations has been submitted to the Public Service Commission. That body has before it also, the question of tariff amendments, adjusting rates in proportion to coal costs.

In the absence of the chairman of the Engineering Committee, Thomas Sproule, Philadelphia, reported that the Public Service Commission has adopted in its entirety the crossing recommendations of the committee. Satisfactory progress in conjunction with the telephone and telegraph companies is being made with regard to the famous 5000-volt clause in joint line agreements.

In answer to a question by P. J. Morrissey, Johnstown, Mr. Sproule stated that the matter of central stations obtaining compensation ratings dependent upon the quality of the risk similar to the practice in other lines of industry is now being taken up by the N. E. L. A. in co-operation with the Bureau of Standards.

The usual executive session was held on the morning of September 8, after which the following officers were elected to serve during the following year:

President, Henry N. Müller, Pittsburgh; first vice-president, Thomas Sproule, Philadelphia; second vice-president, Ernest H. Davis, Williamsport; treasurer, W. R. Kenney, Connellsville. Executive Committee, Walter E. Long, Philadelphia; F. M. Noecker, Renovo, and Walter Partridge, Clearfield.

IRON AND STEEL ELECTRICAL ENGINEERS' CONVENTION.

Features of Meeting at Philadelphia—Presentation of Numerous Technical Papers.

The Association of Iron and Steel Electrical Engineers held its eleventh annual convention at Bellevue-Stratford Hotel, Philadelphia, September 10 to 14. One of the most important results of the meeting was the presentation of eight or ten technical papers by men who stand high in the technique and practice of electrical engineering as applied to the iron and steel industry. The papers cover a wide range of subjects pertaining to electrical equipment, its applications in this industry, and problems concerning installations and economy of operation; and they constitute a most valuable acquisition to the literature on iron and steel electrical practice. Second only in importance to the papers themselves was the discussion of the many subjects treated therein. A report of those interesting discussions will appear in Electrical Review of September 22.

The convention opened at 9 a. m., Monday, for registration. This was followed by a business session, during which there were reports of committees and election of officers. Monday afternoon, Tuesday and Wednesday were taken up with the reading and discussion of papers; one feature of Wednesday afternoon, however, consisted of patriotic exercises in which Army and Navy engineers made speeches. The annual banquet occurred Wednesday evening, the attendance at which included many ladies.

Thursday's sessions were Standardization meetings, held under the auspices of the Standardization Committee of A. I. & S. E. E. W. T. Snyder, chairman of this committee, made introductory remarks. Motor Standardization data, by the Motor Sub-committee, was presented by F. B. Crosby, chairman. In like manner, Control Standardization, by T. E. Barnum, chairman of Control Sub-committee, and Crane

Standardization, by D. M. Petty, chairman of Crane Sub-committee, were next presented.

Friday's forenoon session was devoted to reading and discussion of papers; the afternoon to the inspection of plants, including visits to Cramp's shipyard, Midvale Steel Company plant and Baldwin Locomotive Works.

Safeguarding Electrical Equipment.

The first paper, presented by Walter Greenwood, had special reference to the use of safety appliances to protect those who attend and operate electrical equipment and electrically-driven machines. The retarding influence of many, for whom safety appliances were destined to benefit and protect, were noted. In this connection, the experience in adopting automatic couplers, air brakes, protectors for the eyes, and automatic stops for preventing over-travel or over-speeding, were cited. In securing the adoption of methods deemed best for the safety of operations, Mr. Greenwood thought a stand in relation thereto by this association would be sufficient. Cases in which this association had originated codes and specifications had been adopted by the manufacturers were referred to in support of this. In such cases he thought the association should be honored by crediting their origin.

Heroult Electric Furnaces.

This subject was treated in an interesting paper by Walter C. Kennedy. He referred to the fact that the electric furnace now had a permanent place in the steel industry. He traced the development of the electric arc furnace for the manufacture of steel and other ferrous alloys from that of five or six-ton capacity to those of 10 and 15 tons, describing the equipment adopted in connection with their operation. Data were given in tables, which give a clear outline, for instance, of a 15-ton furnace, with the number and sizes of electrodes and other facts in the construction of such a plant. In his paper line drawings and diagrams are presented in connection with interesting and valuable information on this important subject.

Electric Installations in Steel Industry.

The first paper on Tuesday was by Brent Wiley, who discussed "Factors Relating to the Economical Generation and Use of Electric Power in the Steel Industry." His paper dwelt upon the importance and magnitude of the steel industry and the necessity for improved milling equipment for increasing capacity and improving quality of steel, always keeping in mind the question of economy of operations. Conclusions were drawn from many phases of power generation as developed during the past 10 years. The matter of meeting the rapidly increasing demands for steel showed the necessity for planning for future development.

Central Station Power Supply.

Joseph McKinley and Ray L. Baker presented the second paper on Tuesday on the subject of "Central Station Power Supply to Iron and Steel Industry." The tremendous demand for electricity, it was pointed out, has stimulated the central stations to such an extent that a very large percentage of this power is supplied by them. Special attention in this paper was given to the discussion of central-station service, its relation to the consumer, both as to cost and quality of service. As distribution systems usually cover large areas to meet the demands of consumers, the subject of distribution was taken up and discussed, this being accompanied by diagrams. Special reference was made to the interconnecting of stations of neighboring companies.

Electrical Reversing Blooming Mills.

The first paper on Tuesday afternoon was by Ralph D. Nye on "Electrical Reversing Blooming Mills." In this paper the subject of the electric drive as applied to rolling mill equipment was ably presented.

This was followed by D. M. Petty's paper on

Electric Drives for Reversing Rolling Mills.

Mr. Petty referred to the fact that two or three years ago literature on this subject was confined largely to comparisons of the electric drive with that of the steam engine. In his paper the object was to point out some of the things that may be improved in the electric drive as its use was now admitted to be superior to that of the steam engine. A line drawing showing an installation of the Ilgner system was described and discussed. The matter of cost of equipment, efficiency and reliability were the pivotal points taken up.

Fuel Economy by Co-operation.

Joseph G. Worker presented a paper Wednesday morning on a subject of "Fuel Economy by Co-operation in Establishing a Better Practice in the Operation of Stokers and Boilers."

Turbogenerators.

This subject was discussed in a paper by Richard H. Rice, more definite reference to the substance of which will probably be given later.

Carbon Brushes, Manufacture and Use.

This subject was ably presented in a paper by E. H. Martindale. Much of his matter on this subject has recently been appearing in the Electrical Review.

Grab Bucket Coal Hoists.

James Farrington and R. H. McLain gave a paper on "Grab Bucket Coal Hoist Operated by Alternating Current Motors with Dynamic Breaking and Regenerative Breaking." This subject, which is an interesting one, was illustrated by a number of cuts showing the application of this equipment to coal handling.

Tool Steel Gears and Pinions.

E. S. Sawtelle's paper on "Tool Steel Gears and Pinions for Mill and Industrial Service," and the method of manufacturing was treated in an interesting manner in which the physical and chemical properties of material were discussed. The subject is an interesting one and this paper will be of special value to those concerned in the subject.

NATIONAL CONVENTION OF ELECTRICAL CONTRACTORS AT NEW ORLEANS.

Tentative Program—A Meeting of Importance to Electrical Men.

The seventeenth annual convention of the National Electrical Contractors' Association will be held at New Orleans, La., on October 9 to 13, inclusive, 1917. Convention headquarters are to be at Hotel Grunewald. The following tentative program has been announced, the official program to be sent out later. The feature of Monday, October 8, will be a meeting of the national Executive Committee. Tuesday's program will consist of a meeting of the National Board of Directors in convention hall; this will be followed at 1:30 p. m. by a Round Table School of Instruction on Unit Labor

Costs, presented by N. E. C. A. Cost Data Committee, assisted by a similar committee of the Ohio State Association.

Wednesday, October 10: Opening of the convention by Robley S. Stearnes, president of the association; address of welcome, on behalf of the City of New Orleans, Hon. Martin Behrman, mayor; response by W. K. Tuohey, vice president, National Electrical Contractors' Association; address by Governor Ruffin G. Pleasant, "Welcome to the Pelican State"; response by John R. Galloway, past president, National Electrical Contractors' Association; address by S. E. Doane, chief engineer, National Lamp Works, Nela Park, Cleveland, Ohio; address by Wm. J. Clark, manager, traction department, General Electric Company, "Electrical Manufacturers of America as Compared With Those of Foreign Countries"; Franklin Overbagh, general secretary, Electrical Supply Jobbers' Association, "The Jobber"; J. Nelson Shreve, treasurer, Electric Cable Company of New York, "Contractors' Obligations in War Time"; Lynton T. Block, manager, Utilities Indemnity Exchange, "Insurance for the Electrical Contractor"; M. S. Sloan, vice president and general manager, New Orleans Railway & Light Company, "The Co-operative Central Station"; J. M. Wakeman, general manager, Society for Electrical Development, "The Relations of the Society towards the Contractor-Dealer."

This will be followed by an executive business session to which members only are to be admitted. At 9 p. m. the delegates and their friends will meet for reception and dance on first mezzanine floor at Hotel Grunewald, with C. S. Barnes, chairman of the committee, in charge.

Thursday, October 11—10 a. m.: Business Session, open to all in the electrical contracting business, whether members or not. Special order of business as follows: Report of Universal Data and Sales Book Committee—G. M. Sanborn, past president, National Electrical Contractors' Association, chairman; report of resolutions committee followed by an address by Wm. L. Goodwin on the "Ills in the Industry and their Remedies Through the Proposed National Association of Electrical Contractors and Dealers." This will be followed by open discussion and disposition of resolutions committee's report; report of standing committees. At 10:30 a. m., ladies present will be conducted through "Vieux Carre," the French quarter shopping district, by the committee in charge. Luncheon served to ladies, 12:30 p. m., at La Louisiane restaurant; business session for members only; at 3 p. m., a special performance will be given for ladies at New Strand theater; entertainment for members and guests at "Spanish Fort" by New Orleans Jovian League, to which special electric train will leave at 6 p. m. Supper and entertainment will follow at Trauchina's restaurant.

Friday, October 12—10 a. m.: Business session for members only; presentation of attendance badges by J. A. Fowler, National Committeeman of the "N. E. C. A."; at 12 a. m. there will be a special trip for the ladies only, to "Bohemia," where buffet luncheon will be served; at 2 p. m. an automobile trip "Seeing New Orleans"; delegates will join the ladies at the N. O. Country Club, where official picture of members and guests will be taken at 3 p. m.; automobiles for guests and members will be in waiting at University Place entrance, Grunewald Hotel.

7 p. m.—Annual dinner, members and guests, in the "Cave," Jas. R. Strong, past president of the N. E. C. A., toastmaster and song leader. One of the features of the evening will be the presentation of the president's emblem by Ernest McCleary, past president of the N. E. C. A.

Saturday, October 13—9 a. m.: Organization meeting of the National Board of Directors. 10 a. m.—Organization meeting of the National Executive Committee. 12 a. m.—Steamer leaves head of Canal Street to view the Harbor of New Orleans, Chalmette Monument, Naval Station and Cotton Warehouses. Refreshments will be served aboard the boat. Members and guests are invited.

All meetings will be held at the national headquarters, Hotel Grunewald, Baronne and Canal Streets. The Electrical Exhibit will be held under the management of the Hotel Grunewald during convention week in the lounge of the hotel. An exhibitors' club for the entertainment of their guests will be established in the hotel. All convention sessions held in main Convention Hall—twelfth floor.

Annual Convention of Jovian Order to be Held in New York.

Just at the time of going to press announcement has been made that the annual convention of the Jovian Order will be held in New York City, October 22 and 23, at the Hotel McAlpin. Aside from matters of special national interest there will be presented important changes in the existing method of operation of the Jovian Order. A special message relative to the meeting has been prepared by Henry L. Doherty, reigning Jupiter. Further details of the meeting will be given in our next issue.

Meeting for Revision of Electrical Code Finally Decided On.

The meeting of the Electrical Committee of the National Fire Protection Association for the consideration of changes in the National Electrical Code, has finally been set for October 23 and 24 at the rooms of the New York Board of Fire Underwriters, 123 Williams Street, New York City. This meeting is the twenty-first annual meeting and was first called for March 28 and 29. It will be recalled that on account of some litigation this meeting was adjourned and the date for it has now been definitely fixed. A general outline of the proposed amendments to the Code was given in the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN of February 24, 1917.

Association of Edison Illuminating Companies Annual Meeting.

The annual meeting of the Association of Edison Illuminating Companies was held in New York City, September 11. In great contrast to the usual annual conventions of this old association was the meeting this year, which was called merely for statutory reasons. The attendance was rather small and the matters considered were entirely of a business character, combined with matters of special national interest. All of the officers and committees were re-elected for the ensuing year.

John W. Lieb, chairman of the National Committee on Gas and Electric Service, made a report covering the very important work undertaken by this committee in co-operation with the Council of National Defense. A report of the Committee on Revision of the Constitution was also presented. Reports of all executive officers were received. A resolution of condolence was adopted relative to the death of E. H. Johnson, formerly very active in the association.

New Electrical Appliances

A Review of the Latest Developments and Information Respecting Electrical and Kindred Mechanical Appliances

AN ECONOMICAL METHOD FOR MOVING ASHES.

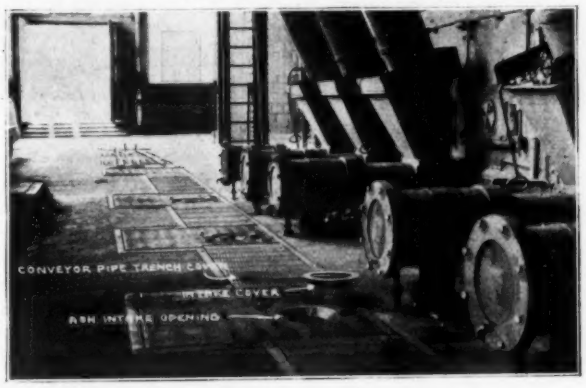
Steam Jet Conveyor System Eliminates Hand Labor—Effects Saving Over Other Methods.

In these days of scarcity of labor and high production costs, every attention is being given methods that will tend to release labor for Government service and that will increase efficiency and effect economies. The disposal of ashes from power plants, which in normal times is given but little attention, has become an important operating problem as it is becoming extremely difficult to obtain men for this service at the low wages this work justifies, when opportunities are so numerous for more pleasant work at considerably higher wages. Naturally consideration is being given automatic coal and ashes handling systems and central-station managers are finding that even under the old conditions with low wages, the mechanical systems are more economical and much more satisfactory.

The American Steam Conveyor Corporation, 326 West Madison Street, Chicago, and 50 East 42nd Street, New York City, specializes in steam conveyors for the non-mechanical disposal of ashes, soot and coal siftings. The equipment and devices used in the ash-

Ashes Are Conveyed from Plant to This Overhead Hopper and Dumped Into Cars.

disposal systems installed by the company are of its own manufacture. Types of steam-jet conveyors vary some as to their adaptation to plant served. In general, this conveyor consists of a heavy pipe line of hard, cast iron, and patented fittings, with removable, hard-metal wearing parts. This is installed in the boiler house, with ash intakes at most convenient



View of an Installation Showing Neatness of Boiler Room.

points. These conveyors are made in 3-inch, 4-inch, 6-inch and 8-inch sizes, although special sizes are built to meet conditions for which standard sizes are not adapted. The 6-inch and 8-inch conveyors are used for ashes; the 4-inch and 6-inch for soot from economizers and breechings, and ashes from the combustion chambers of boilers; the 3-inch and 4-inch sizes for handling coal siftings from V-grate and chain grate stokers.

There are no moving parts. In operating the conveyor, a steam valve is opened, creating a suction in that part of the line between the ash pit and the steam jet. As the ashes or other material are raked into the intake they are shot through to the disposal end into ash pit, bunker, hopper or car, according to the plan of disposal and kind of material. In this operation the ashes may be elevated 100 feet or higher, and discharged 200 to 300 feet away from the power station. The operation is clean and almost noiseless, and 3 to 12 tons of ashes may be handled in an hour, according to the size of the conveyor in use.

It is estimated that the cost of removing boiler-room ashes by hand runs 50 to 60 cents per ton, and the cost of handling with American steam-jet conveyor, it is figured, ranges from 6 to 10 cents per ton. It is claimed the latter cost estimates are based on results at 500 plants in which these installations have been made.

Fittings of gray iron body and cover plates are held in place by sherardized studs and thumb nuts; and wear liners of rough castings protect the fittings from wear resulting from moving material; these liners extend to the flanged face of fittings, leaving no part exposed. In this company's illustrated literature are presented cuts of its long-sweep steam unit, composed of split elbows of 22½-degree arc, its patent impact

elbow for use where a right-angle turn is required between the steam unit and the end of the discharge line, and its patent intake tee, with square anvil top. It is explained that since the conveyor pipe, in suction head-

View of a Two-Way System.

ers, is one inch thick throughout, and the wear occurs only on the bottom of the pipe, it is made possible to turn the pipe four times before it is worn out, thus prolonging its use, by adding new liners in the intake tee only. The 45-degree elbow is likewise illustrated, assembled and in sections, also the hard-metal liners to take up the wear where the material makes this turn.

Numerous illustrations in the company's bulletin show typical installations of steam-jet conveyors. Included among these are installations in a number of steam-electric plants of large boiler capacity; that of

Close-Up View of Ash Intake.

Bryant Paper Company, Kalamazoo, Mich.; of assembly plant of Ford Motor Company, Long Island City, N. Y. Ash handling at the Hotel Morrison, Chicago, is by American steam-jet conveyor. An illustration of this installation shows the ash tunnel 56 feet below street level, the steel ash hopper being situated in the alley 86 feet above the tunnel. In this case the ashes are hauled away in wagons into which they are discharged by gravity from the hopper. A clear illustration of the ashes being raked into the intake tee, at the bottom of the ash pit in front of one of the stokers, is that showing an installation in the Fred Ruepping Leather Company's plant, Fond du Lac, Wis. At the plant of American Car & Foundry Company, Detroit, the steam-jet conveyor discharges ashes into a storage hopper erected above the railroad track. The hopper has capacity to hold two car-loads of ashes, which discharge into standard sized railroad cars to be hauled away. The conveyor in discharging ashes into this hopper throws them against a baffle at the top, from which they drop into the hopper.

Motor-Driven Bull Frame.

For drawing wire of sizes from 7/16 to 1 inch diameter, a horizontal-spindle bull frame is made by the Morgan Construction Company, Worcester, Mass. It will handle square, hexagonal, and round sections, with a pull at the die ranging from 10,000 to 20,000 pounds.

A special feature of this line of machines is a winding block so arranged that while the pull is always close to the main bearing, the coiled wire moves out to the end of the block in a regular helix without bunching or crowding. In addition to the safety afforded by the quick-stopping characteristic of individual drive, a friction clutch is contained in each block which instantly disengages the block from the mechanism. Thus, by the movement of the clutch lever, the drawing may be stopped at any time regardless of the strain on the block.

This machine, which is intended for heavy work at high speeds, is equipped with a 150-horsepower type CS Westinghouse induction motor. Other sizes are driven by motors down to 50 horsepower.

The Carwen Dynamic Balancing Machine.

The accompanying illustrations show a new machine by which true running balance may be quickly secured in an armature, engine crankshaft, turbine rotor, fan, or other high-speed rotating part. As is well known, such parts may be balanced on centers without being in running balance. The purpose of this machine is to take such a part, after it has been put in static balance, and measure the exact correction needed to put it in running balance.

The Carwen machine is built under the Akimoff patents, and embodies the principle of the Akimoff machine described before the American Society of Mechanical Engineers in April, 1916, and the Society of Automobile Engineers in January, 1917. It is, however, much more convenient to operate owing to all the adjustments being made by turning the handwheels while the machine is running. For this reason the new machine will handle fully twice as many armatures or other objects in a day as the old machine.

The principle of the machine is indicated diagramatically in Fig. 1. The armature *A* runs at the same speed and in the same direction as a dummy shaft *C*. This shaft carries weights *D* and *D* which may be shifted toward or from each other.

Shafts *A* and *C* are supported together on a bed *B* which is hinged at *E* and free to vibrate vertically at the other end under the influence of any unbal-

anced couple in *A* or in the weights *D D*. When the weights are brought close together they exert no couple, but any running unbalance in *A* will cause the bed to vibrate. Weights *D D* are then moved to such positions that the couple they exert is opposite and equal to that exerted by *A*. The vibration then stops. Since the weights *D D* and their radius from the center of shaft *C* are predetermined, it only remains to measure their distance apart to calculate the couple they exert. With this known, it is easy to calculate what weights should be added to or subtracted from points of known radius at known distances apart in *A* to produce a similar couple in the opposite direction.

Since the object to be balanced may be a six-throw crankshaft, electric armature or any of a number of other high-speed rotating pieces, the plane of unbalance may not be known in advance. Therefore, it is desirable to be able readily to rotate shaft *C* with respect to *A* till the desired position is found. It is also desirable to shift weights *D* and *D* on their shaft without stopping the machine. All these points are covered in the new machine shown.

The machine has two box pedestals, one of which supports the right-hand end of the bed by means of a heavy spring-plate fulcrum or "hinge" *E*. The other end of the bed simply rests on a short helical spring or springs *F* and is steadied by a flat spring which permits it to vibrate vertically but in no other direction. A micrometer indicator connected between the bed and the left-hand pedestal indicates small vibration.

An electric motor *G* suspended from the bed drives the piece to be tested through a train of gears and a loose coupling. The weights are splined on the shaft and are controlled by forks hung from a right and left-hand screw *I*, which in turn is controlled through two pairs of miter gears by the left handwheel. Thus the weights are shifted towards or away from each other while the machine runs.

To the right-hand fork is attached a small rack which operates the index finger on the semicircular dial through a pinion. This dial indicates the relative movement of the weights, but is graduated to read in ounce-inches, i. e., the product of one of the weights by their radius and by the distance between them. Fractional readings are taken from a graduated dial behind the left-hand wheel.

To permit shaft *C* to rotate with respect to the object under test it is not driven directly by the electric motor, but indirectly through a planetary gearing consisting of a spur pinion on the motor shaft, an

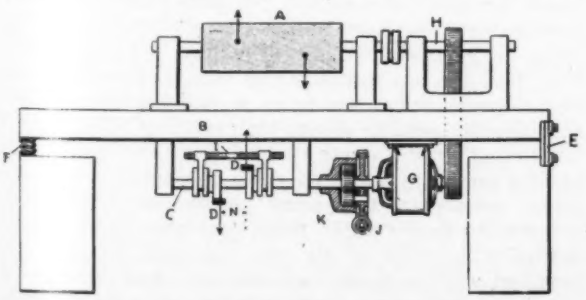


Fig. 1.—Diagram of Principle of Operation, Carwen Dynamic Balancing Machine.

internal gear *K* on shaft *C*, and an idler pinion carried by a stationary cage. This cage is inclosed and has a worm gear cut on its periphery which engages the vertical worm *J* controlled by the lower right handwheel. By rotating the cage in this manner any desired angular position for shaft *C* can be obtained without stopping the machine.

The procedure is, first of all, to put the object

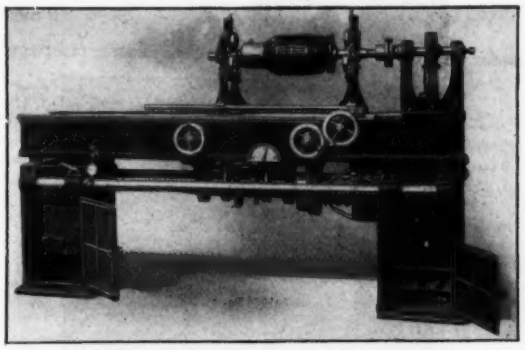


Fig. 2.—The Carwen Dynamic Balancing Machine.

under test in correct static balance so that it will stay in any position on level ways. This is an entirely separate operation.

Having done that, the piece is put in the Carwen balancing machine and run at a moderate speed with the weights *D D* a small distance apart. The lower right handwheel is then turned till a position is found in which the maximum vibration occurs, this being more quickly found than the position of minimum vibration. Shaft *C* is then turned 180 degrees by the handwheel, thereby securing the minimum vibration for that position of the weights.

Next the left handwheel is used to move the weights slightly in and out until the best position is found. Finally the right handwheel is again used to make whatever slight correction may be needed in the angular position of shaft *B*. This completes the operation, and the machine now runs without vibration. To stop vibration quickly when a change in adjustment is made, the small finger lever just to the left of micrometer indicator is raised until it touches the bed.

To apply the readings of the machine to the object tested a set of charts is used from which the readings in ounce-inches are converted directly into diameter and depth of holes to be drilled at the specified radii and specified distances apart. This is usually more convenient than adding weights.

The makers, the Carlson-Wenstrom Company, Philadelphia, Pa., state that the size here shown will easily handle 100 armature in an eight-hour day. Since the machine actually measures the amount of unbalance and prescribes the exact amount of metal to be added or removed at definite points, it follows that there is no guesswork about its operation and no unusual skill is required.

Improved Outdoor Switch-House Construction.

Large power companies are coming more and more to buy portable switching and metering equipments in quantity in order to be in position to connect up desirable loads along transmission lines. They are thus enabled to reach small plants where the load is not large enough to warrant the expense of a substation with indoor apparatus. The increasing popularity of this form of equipment has naturally resulted in a steady development in the design and construction of switch houses, especially with a view to increasing their accessibility.

A very open type of construction has recently been

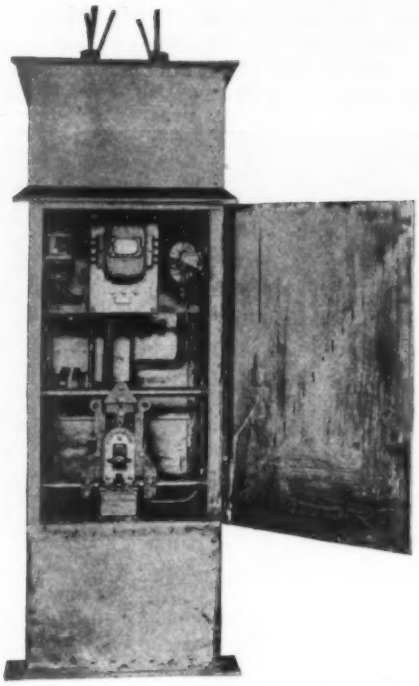


Fig. 1.—Switch House With Bracket-Mounted Circuit-Breaker.

brought out by the Westinghouse Electric & Manufacturing Company, that provides the maximum of accessibility. In this switch house, which is shown in Fig. 1, the oil circuit-breaker is mounted on a specially constructed bracket and the meters are mounted on a slate slab. The bracket is so designed that it will take different sizes of breakers.

This method of mounting the circuit-breaker has the advantage of being easily accessible for the inspection of wiring, removal of oil tanks, inspection of contacts, and replacement of fuses protecting the voltage transformers—all very desirable features not possessed by switch houses employing panel-mounted circuit-breakers.

A ground-mounted switch-house with panel-mounting circuit-breaker is shown in Fig. 2. The circuit-breaker and instruments are all mounted on one slate slab, and while the construction is not as open as with the bracket-mounted breaker, it has a very neat and pleasing appearance.

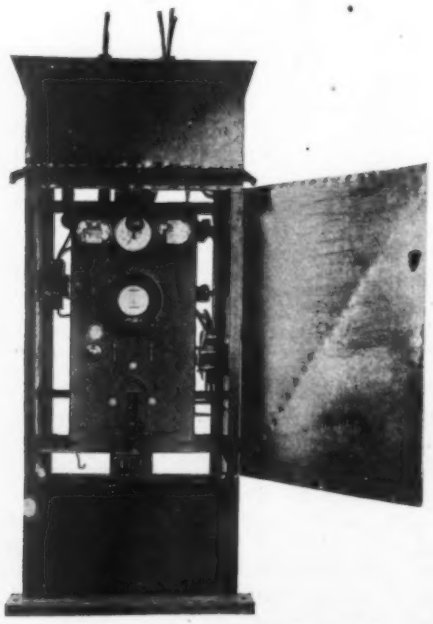


Fig. 2.—Switch House With Panel-Mounted Circuit-Breaker.

The tendency of power companies to buy this type of equipment in quantity is well illustrated by the Iowa Light, Heat & Power Company, which has been furnished recently with twelve switch houses of the ground-mounting type, and the Northwestern Ohio Light Company of Van Wert, Ohio, with five switch houses of the pole-mounting type, both sets being of Westinghouse manufacture.

New Porcelain Pendent Switch.

There are a great many places where pendent switches are especially desirable. In factories, shops, stores, cellars, refrigerators, etc., they are extensively used. In many such installations the switch is exposed to dampness and other corroding influences which deteriorate and destroy metal switches. To meet this demand the General Electric Company has designed a new all-porcelain pendent switch.

General Electric Porcelain Pendent Switch.

This G. E. pendent switch is small and compact, yet very strong and rugged. The operating mechanism is of the quick-make-and-break type, and is rated at 3 amperes, 250 volts, and 6 amperes, 125 volts. The outer porcelain shell is in two parts.

The V & K Electric Water Supply System.

One of the most useful services which electricity can perform in the isolated home is to furnish a supply of running water. Electric house pumps have proved very desirable to both the user and the central station, since they lighten the former's labor and build a good load for the latter. Quietness and freedom from maintenance difficulties are of prime importance where the pumping plant is to be installed in the cellar and looked after only by a handy man.

These qualities have been kept foremost in the design of the V & K water supply system, manufactured by the Vaile-Kimes Company, Dayton, Ohio. Compactness has been secured by mounting all apparatus on a substantial cast-iron base. The pump itself is of the horizontal piston type, belt-driven, with single speed reduction from a Westinghouse motor specially designed to secure high starting effort. Water is pumped from a depth of 22 feet or less into a tank against an air pressure of 35 to 50 pounds per square inch. To replace that small proportion of air which is absorbed in the water, means are provided for automatically introducing air into the tank. Pumps are supplied with capacities of 120, 210, and 360 gallons per hour, and tanks, either black or galvanized, in sizes of 40, 80, 120, 220, and 315 gallons.

The equipment is entirely automatic and requires little or no attention after installing. A pressure-actuated switch controls the motor so that the pressure in the system is maintained at all times at any value from 35 to 50 pounds.

Activities in the Trade

Walter **A. Zelinker Supply Company,** St. Louis, Mo., makes a special list of offerings in its Tank Bulletin No. 224. These comprise pressure, storage, car and acid tanks; also elevated tanks, stand pipes, reservoirs and vats.

The **Domestic Electric Company,** Cleveland, Ohio, has increased its capitalization from $50,000 to $100,000, to meet the increased volume of its business. This company makes a specialty of small motors, and caters largely to the resale trade.

The **Crocker-Wheeler Company,** Ampere, N. J., will build a new five-story, reinforced concrete plant at Fourth Avenue and Twelfth Street, Newark, to cost about $163,000. The structure will be about 100x200 feet. The company has also acquired the foundry of Edward Maher's Sons, 216 Berlin Street, Newark, N. J., for an extension to its works.

Universal Valve Company, Burlington, Wis., in the manufacture of Knudsen packless swivel joints, has produced three types, A, B and C, sectional views of which are given in the company's booklet. The types B and C are adapted to conditions in which extreme flexibility is required. Several illustrations of installations are shown in which these joints are in use.

Mechanical Rubber Company, Cleveland, Ohio, which manufactures sixteen brands of splicing and friction tape, guarantees them to be free from dirt and pinholes, and to contain no free sulphur. The reason for the numerous brands is that each one is specially suited to certain duties, and the engineering department of this company will gladly advise as to the one best suited to a given requirement.

G. & W: Electric Specialty Company, 7440 South Chicago Avenue, Chicago, Ill., has been appointed distributor of the Schweitzer & Herz oil compression subway and overhead cutout, a description of which appeared in the ELECTRICAL REVIEW of September 8. This company and the Chemelectric Company, Chicago, are the sole distributors for this new product, which is receiving a very favorable reception among the leading central-station companies.

Reliance Electric & Engineering Company, Cleveland, O., has issued Bulletin No. 1014, on the Reliance adjustable-speed motors, of armature shifting design. An illustration is given of a direct-current motor that is adaptable to any speed, that develops a constant horsepower output over any range up to 1 to 10. No electric controller is required for producing speed changes Other illustrations follow and principles of operations are discussed. The bulletin is replete with excellent information. Numerous cuts are given of motor connections to machine tools, printing presses and other machines.

Condit Electrical Manufacturing Company, South Boston, Mass., disseminates high-class information in its Bulletins Nos. 413, 414, 415 and 416, all combined in one well printed, illustrated book. No. 413 deals with Condit oil switches and circuit breakers, type E-3, designed for controlling and protecting feeder circuits, transformer banks, and generators where moderate interrupting capacity is required. They are made in 2, 3 and 4 pole, automatic and non-automatic, for manual and electrical operation. Their construction and installation are clearly described and illustrated by numerous cuts. This includes line drawings, showing panel mounting, single and double throw, with dimensions indicated. No. 414 relates to type E-4 oil switches and circuit breakers, of maximum of 500 amperes and 7500 volts. These are similarly described, and cuts of installations both electrically and manually operated are given. No. 415 is a useful presentation of facts on transformers, followed by similar knowledge concerning this company's types B-5, B-4, S-I, and S-C current transformers. These descriptions are accompanied by diagrams and tables containing data of special value. No. 416 sets forth, in the same admirable manner, main features and applications of the Condit induction and synchronous motor panels, of the M-3 type, for use with the various types and phases of motors. The diagrams and tables in this part of the bulletin supply all needed data. The closing pages pertain to the company's type C-3 series overload relays, described and illustrated.

Bailey Boiler Meters Popular in Ohio Plants.—Bailey boiler meters have won favor at the various Doherty plants in Ohio, and at present there are 47 meters either on order or already installed. In addition, 14 more will probably be ordered before long, so that practically all of the Ohio properties will have Bailey meters. The Bailey meter is a combined steam-flow and gas-flow meter, and in fact, combined steam flow meter and CO_2 recorder, and has not the disadvantages which usually accompany the lighter instrument. The Doherty Organization is contemplating sending a man to the Boston factory to supervise their installation and repair.

The Robbins & Myers Company, manufacturer of electric motors, generators and fans, Springfield, Ohio, has adopted two new bonus plans for employees, which are aimed to promote the spirit of co-operation and develop the maximum of efficiency. Plan No. 1 is based upon perfect attendance, and bonuses thereunder are paid monthly. Plan No. 2 is based upon continuous service, the bonuses being paid quarterly. Bonuses for attendance are computed at 3 per cent to 5 per cent on monthly wages; and those for continuous services range from 1½ per cent for 6 months in regular scale up to 10 per cent for 5 years, based on quarterly earnings. The service bonuses, especially, are intended as a means of getting employees to remain permanently with the company.

Synchronous Motors for Power-Factor Correction.—The Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., recently issued an up-to-date circular on the theory and application of synchronous motors for power-factor correction. The publication furnishes a clear and concise explanation of the underlying principles of power-factor correction and its control. A complete set of accurately plotted curves, accompanied by examples showing their application in cases of actual practice, are shown. These curves give the operating men and those unversed in technical calculation, a simple, graphical solution for all problems in power-factor correction likely to arise in ordinary practice. Illustrations and detail description show standard Westinghouse machines for capacities from 200-kilovolt-ampere to 15,000 kilovolt-ampere and for all commercial voltage from 220 to 6600 volts. Exact operating figures, furnished in several cases by members of operating staffs of the companies concerned, show the success of synchronous motors in improving operating conditions.

Arrow Electric Company, Hartford, Conn., with branches at Chicago, New York, Boston, San Francisco and Syracuse, has outlined a plan of advertising for local newspapers of a kind designed to aid in creating business for the electrical dealer, contractor and central station. The plan is especially adapted to campaigns for pushing the sale of special lines or disseminating the idea of adopting electric service. This company's Arrow E lines of wiring devices are effectively presented in the series of six advertisements shown in one of its filing folders. In the printing of these advertisements electrotype cuts are used, in each of which is a mortised space for the dealer's name. Each advertisement relates to a different subject, and for the printing of same there are furnished two cuts of one-column and two-column widths. These are sent free to dealers who handle Arrow E lines. The first advertisement presents a picture that tells the story of the use of an Arrow E pull switch, to pull on a light where it is needed, and so as to waste no current. Duplex receptacles are shown in next cut, in which there are two outlets so that two lights may be used on a table at the same time. The Arrow E electrolier push-button switches are next shown, by the use of which one may turn on just the lights wanted and no more. It is pointed out how the single control switch results in a waste of current. In the next, Arrow E current taps are illustrated. By this arrangement one can make a single socket do the duty of two by the use of a current tap. Similarly, the Arrow E pull-socket attachment, and lock socket are displayed. In each of these advertisements a household scene is presented, giving a touch of realism that rivets the reader's attention to these electrical conveniences.

Men in Government Service

Items of Interest Concerning Power and Electrical Men Who Have Joined the Colors

F. R. BACON, president of the Cutler-Hammer Manufacturing Company, Milwaukee, Wis., has been made a captain in the Quartermaster's Department.

T. E. ASHTON, W. G. Copeland, W. P. Lyon, E. H. Snyder, Ralph Sowers and A. S. Touche, of the Commonwealth Edison Company, Chicago, have been accepted in the second training camp of Officers Reserve, Ft. Sheridan.

CAPTAIN WARREN R. THOMPSON, until recently manager of construction and engineering of H. M. Byllesby & Company, Chicago, was tendered a dinner by his friends in that organization at St. Hubert's Grill, August 16. Captain Thompson was presented with a gold service watch.

DAVID C. GUEST, line-material specialist of the Western Electric Company, Chicago, Ill., has been appointed lieutenant-commander in the United States navy.

F. T. RICE, advertising manager for the Benjamin Electric Manufacturing Company, Chicago, is among those who have been accepted for service in the National Army, and is expecting to be called at any time to join the forces at Rockford, Ill.

E. H. MARTINDALE, sales engineer, National Carbon Company, Cleveland, Ohio, has been commissioned a captain in the engineer Officers' Reserve Corps and expects to be called for service immediately. Captain Martindale is the author of a series of important articles which are being published in the ELECTRICAL REVIEW, dealing with brush troubles. He is a member of the American Institute of Electrical Engineers and chairman of the Industrial and Domestic Power Committee.

NAMES of the recent graduates of the aviation schools of a number of colleges of the United States are published in Official Bulletin, Washington, D. C. Graduates from that branch of the University of Illinois are as follows: John M. Grider, Bradley C. Lawton, Walter F. Halley, Forest T. McCook, James W. Stokes, Marvin K. Curtis, Julian C. Stanley, John N. Buckley, Frederick M. Byerly, Julian Camp, Otto Ferguson, George A. Foss, Karl J. Herkert, Jr., Donald B. Kennedy, B. O. Lindsay, Edwin A. McDonell, Robert N. McDowell, Wilbur H. McEachran, Harlow R. Price, James M. Richardson, Paul F. Sanborne, William L. Shaffer, Herbert H. Teichman, Josiah J. Peques, Ule T. McCurry, Lawrence K. Callahan, James M. Coburn, Jr., Elwood D. Stanberry.

COLONEL JOHN J. CARTY, United States Army, Signal Corps, chief engineer of the American Telephone & Telegraph Company, is now actively engaged in the important duties of his office. On August 15th Colonel Carty was promoted from a major in the regular army to colonel and will serve in this country and abroad until the end of the war.

MAJ. W. K. PALMER, Engineer Corps, for the past 16 years consulting engineer at the head of the W. K. Palmer Company, Kansas City, Mo., has discontinued his business for the period of the war because of his service with the army.

ROLL OF HONOR.

The electrical industry, perhaps to a greater extent than any other industry, has answered the call of the Nation for men. As this is a war of engineers, naturally the technically trained men in the electrical industry have been in great demand and they have responded with splendid patriotism. Many of the large utility and industrial corporations have assigned men for Government service aside from those who have voluntarily entered or been called for service.

THE ELECTRICAL REVIEW will *welcome news concerning men who have entered the service or who are engaged in any patriotic duties.*

RAYMOND T. BALDWIN, a director of the Lux Manufacturing Company, Hoboken, N. J., has returned to France to serve in the aviation department of the United States. Mr. Baldwin spent the past year in that country in the service of the Harje formation, a hospital division composed of Harvard class men.

COMMONWEALTH EDISON COMPANY'S employes responded with emphatic promptness when the 11th Regiment, I. N. G., was being organized for home guard duty in the state of Illinois. The call for 65 men from the Edison company ranks resulted in 220 applications. The Edison Infantry Company was formed, with Herbert A. Fife, of the Edison engineering department, as captain, and William R. White, of information bureau, as first lieutenant. Both these men are well advanced in military tactics. The company will join the regiment at Camp Lincoln, Springfield, for a few weeks of training, and will then return to their civil occupations, subject to call for home guard duty

DETROIT EDISON employees, to the number of several hundred, are in military service. Included in the list are 27 commissioned officers. There are seven of the rank of captain and nine of first lieutenant. Those having captaincy commissions are: W. A. Bergin, of electrical construction department; P. D. Foster, accounting; John McCabe, operating; R. F. Hunt, construction engineering; B. N. McGregor, accounting; J. M. O'Dee, purchasing; O. A. Odjard, production. There are over 50 non-commissioned officers, thirty or more in the Signal Reserve Corps, and about the same number in the Navy.

MAJOR PETER JUNKERSFELD, formerly assistant to Vice President Loomis A. Ferguson of Commonwealth Edison Company, Chicago, now supervising construction quartermaster in the National Army, is one of the busiest men in the service. His duties are organizing the forces and directing construction of cantonments in the central and western states.

COMMONWEALTH EDISON MEN, 19 in number, received commissions at the completion of Officers' Reserve Training course at Fort Sheridan, near Chicago. Their names and ranks are as follows: Eugene D. MacEwing, captain, Coast Artillery; Edwin C. Mayer, captain, Coast Artillery; Howard B. Maguire, second lieutenant, Coast Artilley; Walter A. Mead, second lieutenant, Regular Army; Stewart M. Heberling, second lieutenant, National Army; Leslie L. Anderson, John H. Hackley, and Harry H. Van Hala, second lieutenants in Infantry; Paul V. Galvin, Solon L. Reeves, second lieutenants, Artillery; Herbert H. Behr, Karl E. Hobart, Chas. J. Rewald, second lieutenants, Regular Army; Arthur E. Grunert, and John B. Jackson, captains, engineers; Frank A. Lang, second lieutenant, Infantry; Secor Cunningham, Jr., second lieutenant, field Artillery; John L. Holman, Edward A. James, Charles P. Mottz, ranks not announced.

MEN of H. M. Byllesby & Company's staff who are in military service include one brigadier general, one captain, three first lieutenants, one second lieutenant, four unassigned officers in the officers reserve, one wireless operator, five privates in the army, one chief yeoman and two yeomen in the navy. Brigadier General George H. Harries, vice president of the Byllesby company, is in National Army service, at present stationed at Deming, N. M. Warren R. Thompson, whose position with the company is that of manager of the engineering department, holds a captaincy in the U. S. Army Engineer's Corps, now at the Rockford (Ill.) cantonment; C. A. Bessey, assistant engineer for the company, is a first lieutenant, now at Rockford; R. T. Purchas, assistant purchasing engineer, is a first lieutenant in the aviation service; A. H. Sayce, assistant manager, is now with the second Officers Reserve, Ft. Sheridan, unassigned. Other Byllesby employes in military service are as follows: A. F. Hogan, C. E. Noerenberg, Arthur H. Kuhn, A. J. St. Aubin, Harold Gore, T. E. Sanford, E. K. McDonald, Arthur Carstens, Harry McKeon, C. H. O'Reilly, Ben Hammer, John J. Nolan, Will J. O'Farrell, Edward Schellhorn, Chester C. Leivis, A. S. Cummings, Albert Palm, S. B. Flynn, and O. F. Flynn.

Personal and Biographical

FRANK WRIGHT, Collingswood, N. J., has been elected superintendent of the Quakertown, N. J., municipal electric lighting plant.

D. F. BURRITT, who has been for some time general superintendent of the National Gas, Electric Light & Power Company, Detroit, Mich., is now general manager of the Utilities Operating Company, Kalamazoo, Mich.

B. C. CONDIT, formerly chief engineer for the Northwestern Electric Company, Portland, Oregon, has been engaged by the Crown-Willamette Paper Company, of that city, as electrical engineer in connection with the construction and equipment of that company's pulp and paper plant on the British Columbia coast.

DR. COLIN G. FINK, for the past ten years in the research laboratory of the General Electric Company, has been appointed head of the new Chile Exploration Company's laboratories, located at 202nd street and 10th avenue, New York City. The work in the new laboratories will be largely research along metallurgical and electrochemical lines.

LYNTON T. BLOCK, attorney and manager for Utilities Indemnity & Fire Exchanges, St. Louis, Mo., recently journeyed through the Canadian Rockies, and will visit Seattle and San Francisco en route home.

L. R. JOHNSON has taken a position as instructor of mathematics in the University of Minnesota, having resigned his position in the Westinghouse Electric & Manufacturing Company's general engineering department.

F. H. LANE, manager of the department of examinations and reports, of H. M. Byllesby & Company, will have temporary charge of the engineering and construction department, succeeding W. R. Thompson, now captain in the U. S. Army, and A. H. Sayce, who has joined the second Officers Reserve Camp.

GEORGE TRIPPLE, city salesman of the industrial department Westinghouse Electric & Manufacturing Company, connected with the Seattle office, has been commissioned first lieutenant in the Engineer Officers Reserve Corps and will train at Vancouver, Washington.

PROF. C. E. CLEWELL of the University of Pennsylvania on September 10, 1917, delivered his fourth annual lecture on the fundamental principles of natural and artificial factory lighting before the junior students in electrical and mechanical engineering in the summer term of mechanical technology at the Sheffield Scientific School of Yale University, New Haven, Conn. This year's work during the four weeks' summer term is under the direct supervision of Prof. Herbert L. Seward of the Mechanical Engineering Department and under the general supervision of Professors Chas. F. Scott and L. P. Breckenridge, heads of the departments of electrical and mechanical engineering at the Sheffield Scientific School.

J. H. STACKHOUSE, formerly with the E. H. Freeman Electric Company, Trenton, N. J., has purchased an interest in the firm of James E. Gleason Company, Chicago, Ill. Mr. Stackhouse entered on his new duties September 12 and will have charge of new lines recently acquired.

HENRY N. MÜLLER, the newly elected president of the Pennsylvania Electric Association, was born in Steubenville, Ohio, on November 30, 1874, where he received his early education in the public schools. At a comparatively early age he became interested in the manufacture of instruments and shortly after entered the employ of the Westinghouse Electric & Mfg. Co. In 1899 the old Allegheny County Light Co. of Pittsburgh claimed his services and he was given charge of electrical repairs and tests. In 1901, Mr. Müller was appointed electrician and later assumed active charge of the laboratory in connection with which he instituted the first general census of conditions on the

Henry N. Muller.

company's property. He became engineer of tests in 1904 and upon the formation of the old Duquesne Light Co. as a competitor in the field, was advanced to the position of electrical engineer. Since the organization of the Distribution Department of the Duquesne Light Co. in 1910, Mr. Müller has been its very able superintendent. To the work of the Pennsylvania Electric Association, he has given freely of his time and energy, having previously served as secretary, vice-president and at various times chairman of the membership, engineering, overhead and company section committees. At present Mr. Müller is also a member of the Underground and Electrolysis Committee of the National Electric Light Association. of the Code Committee of the American Institute of Electrical Engineers, of the Illuminating Engineering Society and of the Pittsburgh Jovian League.

JAMES H. FIERS, of East Grand Forks, Minn., is now superintendent of the municipal light plant at Argyle, Minn.

J. H. SROUFE, Portland (Ore.), manager for NePage-McKenny Company, electrical contractors, Seattle, has become a stockholder in the company. He has had the direction of the electrical equipment of a number of buildings and ships built in Portland.

VAN HORN ELY is president of the United National Utilities Company, of Wilmington, Del. This company controls all companies owned by the American Railways Company and the National Gas, Electric Light & Power Company.

D. R. SHEARER, member of American Institute of Electrical Engineers, has opened an office in the Banon Building, Johnson City, Tenn., to enter engineering practice. He will make specialties of steam and hydroelectric plants and automatic power plants of various types. Mr. Shearer formerly was at Knoxville, Tenn., and later was engineer for the Boone Fork Lumber Company, Shultz Mills, N. C.

E. J. HAINES, a member of the New England Street Railway Club, and well known among its membership, is now First Lieutenant Haines, having joined the United States service in the Signal Corps. Lieut. Haines has, for some years, been in the office of the Superintendent of Motive Power and Machinery of the Bay State Street Railway Company.

Obituary.

DUGALD G. PORTER, general manager of the Peoples' Power Company, died September 1 at his residence in Moline, Ill., at the age of 26. His death, which was unexpected and a severe shock to his many friends, followed a two weeks' illness of typhoid fever. Mr. Porter was born in New York City, May 15, 1891, a son of Mr. and Mrs. J. F. Porter. He attended Iowa State College at Ames and was graduated from it in 1912. After leaving school he accepted a position with the Peoples Power Company. He worked in various capacities in the power house and rapidly advanced because of his exceptional abilities. When F. W. Reimers died, Mr. Porter succeeded him as manager and since that time had been in charge of the distribution of gas and electricity for Rock Island and Moline, and other towns supplied by the company. Mr. Porter was united in marriage with Miss Elizabeth Dow, of Davenport, in May, 1912, who with two children, Dugald Gilbert, aged 3, and Nancy, 4 months old, also three brothers survive him. Mr. Porter's father recently accepted a position as head of the Light and Power Company in Kansas City, having resigned his position in Rock Island as president of the Tri-City Light & Power Company and allied companies.

Current Electrical News

WEEKLY RECORD OF CONSTRUCTION ACTIVITIES

EASTERN STATES.

PORTSMOUTH, N. H.—Rockingham County & Light Power Company, 29 Pleasant street, has plans for the construction of a new power plant addition, to cost about $150,000. Harry M. Hope, 185 Devonshire street, Boston, Mass., engineer.

NEW LONDON, CONN.—Connecticut Power Company has commenced the erection of a new electric power station at Crowell. The Stone & Webster Engineering Corporation, 147 Milk street, Boston, Mass., contractor.

ALBANY, N. Y.—Iroquois Natural Gas Company has made application to the Public Service Commission for permission to construct and operate a gas plant in North Collins.

FLUSHING, L. I., N. Y.—New York & Queens Electric Light & Power Company, 444 Jackson avenue, Long Island City, will build a substation about 94x103 feet, on Lawrence avenue, near Broadway, to cost $50,000. Contract for erection has been awarded.

NEW HAMPTON, N. Y.—Department of Correction is planning for the construction of a new power house at the city reformatory. B. G. Lewis, Municipal Building, New York City, commissioner.

NEW YORK, N. Y.—Interborough Rapid Transit Company is planning for line connections between its power houses at East Seventy-fourth street and West Fifty-ninth street to generate sufficient power to drive any part of its transit system.

NEW YORK, N. Y.—New York Telephone Company, 15 Dey street, has awarded a contract to the E. E. Paul Company, 101 Park avenue, for the construction of a new six-story exchange plant addition at 366-76 East One Hundred and Fiftieth street, at a cost of about $100,000. The company has also awarded a contract for the construction of a five-story exchange building, 98x122 feet, at 224 West Thirty-sixth street, to D. C. Weeks & Son, Inc., 1123 Broadway.

DOVER, N. J.—New Jersey Power & Light Company has been awarded a contract for furnishing service to the plant of the Dover Boiler Works. The works require power to the amount of 180 horsepower.

NEWTON, N. J.—In its annual budget the Town Committee appropriated $8,000 for street lighting for the coming year. It is also planned to make improvements in the electric lighting plant.

SOUTH AMBOY, N. J.—Council has made an appropriation of $3,000 for new street lights to be used during the new fiscal year.

TRENTON, N. J.—The installation of a new "white way" lighting system is planned by the City Commission, including new lights in Warren, Broad, Willow, Market and State streets and Clinton avenue. In this zone there are now 88 lights, and the Commission is arranging for a total of 306 lamps.

UNION, N. J.—Township Committee appropriated $5,800 for street lighting for the coming year in its annual budget.

HARRISBURG, PA.—Harrisburg Railways Company is planning for the construction of a new traction line direct to Steelton, via South Second street.

HAZLETON, PA.—Cranberry Creek Coal Company is planning to completely electrify its properties at Cranberry. The breaker is being entirely remodeled and electric machinery installed. The improvements have been under way for some time past and will represent an investment of about $200,000. Service will be furnished by the Harwood Electric Company, Hazleton.

LEBANON, PA.—Lebanon Lumber Company has awarded a contract to Jacob Weaver, Lebanon, for the installation of electrical equipment at its plant for works operation.

MOUNT JOY, PA.—John H. Witmer is planning to install electric equipment for the operation of the milling plant at Bosslertown, recently acquired.

PHILADELPHIA, PA.—Department of Public Safety is planning an appropriation of $250,000 for the installation of an underground conduit system in the Electrical Bureau to replace the present overhead wires. The Department is also considering the improvement of the police signalling system.

PHILADELPHIA, PA.—Philadelphia Drying Machinery Company has awarded a contract to the Driscoll Company, 1411 Walnut street, for the erection of a new one-story power house, about 25x26 feet, on Stokely street.

PHILADELPHIA, PA.—M. Zifferblatt, 2115 South Eighth street, is planning for the installation of new power plant equipment in his factory at Fourth and Cherry streets.

PITTSBURGH, PA.—Armstrong Cork Company has awarded a contract to the Walker & Curley Company, East End Trust Building, for the construction of a new one-story power house, 50x52, to be erected at its Oakdale works. The structure is estimated to cost about $30,000.

READING, PA.—Metropolitan Electric Company is making rapid progress in the construction of its new hydroelectric power plant at Klapperthal on the Schuylkill River. The power will be transmitted by two water wheels, each connected to a generator.

READING, PA.—J. T. Wilson Company, Inc., has awarded a contract for the construction of a new one-story brick power house addition to its plant at Second and Washington streets. The Beard Construction Company, Berks County Trust Building, Reading, is the contractor.

WAYNESBORO, PA.—Hagerstown & Frederick Electric Company is planning to connect its power lines with the system of the Chambers, Greencastle & Waynesboro Street Railway Company, recently acquired. The power station of the company at Security, Md., will be used to furnish increased power for local service.

WILKES-BARRE, PA.—Wilkes-Barre Company has notified the City Council that for the next six months, or prior to the operation of the proposed new lighting system by the Wilkes-Barre Lighting Company, an increased rate of $1,400 per month for lighting service will be placed in effect.

NORFOLK, VA.—Government has awarded a contract to the J. W. Danforth Company, Norfolk, for the construction of a new power plant and distribution system at its naval base at Jamestown Exposition.

RICHMOND, VA.—Richmond Terminal Railway Company is planning for the construction of a new heating plant, to cost about $13,000.

SOUTH HILL, VA.—Roberts Tobacco Company is planning for the construction of a new addition, about 80x180 feet, and will install new electrical equipment consisting of pumps, engines, boilers, etc. T. E. Roberts is president.

ASHLAND, W. VA.—City will install a white way lighting system; $15,324 available.

MAXTON, N. C.—City is planning for the construction and operation of a new electric lighting plant.

ATLANTA, GA.—Georgia Railway & Power Company has authorized construction of a double track extending to Camp Gordon, 3.2 miles. P. S. Arkwright, president.

TY TY, GA.—Electric lights for the town are being considered. Address Ty Ty Drug Company.

JACKSONVILLE, FLA.—City will extend electric lighting system to South Jacksonville for use of Government shipyard; will construct 6,600-volt cable from substation to Hillyer-Sperring-Dunn plant, now under Government control.

LAKE WORTH, FLA.—City commissioners have authorized issuance of $15,000 bonds for extending waterworks system and enlarging electric light plant; $5,000 will be expended on waterworks system and $10,000 on light plant.

VERO, FLA.—Vero Utilities Company will establish electric light plant now and later an ice plant. Application has been made for incorporation of the company with a capital of $20,000. C. G. Redstone, president.

NORTH CENTRAL STATES.

MONGO, IND.—Farmers' & Merchants' Light & Power Company has asked permission to buy an additional mill dam site for power purposes.

NEW ALBANY, IND.—City Council has adopted resolutions rejecting offer of New Albany Street Railway Company, the Louisville & Southern Indiana Traction Company, the United Gas & Electric Company and the New Albany Water Works, all subsidiaries of Middle West Utilities Company, to surrender their franchises and operate under the State Public Service law.

Business is Good

Our volume of business is tremendously greater than at any previous period, and we presume our condition is no different from that of most other reputable concerns.—A. L. Wilkinson, Ohio Brass Company, Mansfield, O.

CANTON, ILL.—Canton Gas & Electric Company will build lines between Ipava and Havana and between Ipava and Lewistown. The company will remove the south end of its building here and use that section as a powerhouse, to serve as a distribution or transformer station.

WAUKEGAN, ILL.—City Council is formulating plans for construction of a modern electric light plant.

ALMA, MICH.—Citizens have voted to grant a 10-year extension to electric line franchise, held by M. Pollasky and associates, making it run for 30 years. Improvements will be made.

BERRIEN SPRINGS, MICH.—Indiana & Michigan Electric Company, which recently bought the Ligonier plant, has asked permission to construct a pole line from Elkhart to Ligonier.

COPPER CITY, MICH.—Council is planning ways and means to install light, water and sewer systems.

GRAND RAPIDS, MICH.—Consumers' Power Company will rebuild power plant at a cost of $20,000. Modern improvements will be installed.

PORTLAND, MICH.—Council has adopted boulevard system of street lighting for downtown district and appropriated $5,200 for the purpose. About 48 lights will be installed now and later all paved streets will be changed over to newer method of lighting.

MONTICELLO, WIS.—City Council is considering an issue of $5,650 for improving municipal electric light system.

PONETTE, WIS.—An election will be held to decide the question of issuing $7,000 for repairing the dam.

SHEBOYGAN, WIS.—Eastern Wisconsin Electric Railway has let contract for addition to power plant, to cost $25,000.

RICE, MINN.—D. I. Bouck, village clerk, and Earl D. Jackson, consulting engineer, St. Paul, will receive sealed bids until Sept. 21 for furnishing labor and material for the construction of electric transmission line and distribution system for Rice, according to specifications on file in their offices.

SAC CITY, IOWA.—Proposition to issue $60,000 electric light and power plant bonds carried.

HANNIBAL, MO.—Hannibal Railway & Electric Company will make three extensions to its lines.

OAK, NEB.—Proposition to issue $25,000 for electric light plant carried.

SOUTH CENTRAL STATES.

LOUISVILLE, KY.—Government has had plans prepared for the construction of a new power house addition to its works on the Ohio River at Dam No. 41, to cost $8,500.

LOUISVILLE, KY.—American Tobacco Company is planning for the construction of a new power house addition, to cost about $8,000. D. X. Murphy & Brother, 713-20 Louisville Trust Building, are the architects.

ANNISTON, ALA.—Southern Bell Telephone & Telegraph Company will expend $75,000 in providing telephone service for army camp here.

CLANTON, ALA.—Alabama Power Company will build a lock on Coosa River, to cost $6,000,000, to meet necessity for increased power production.

MONTGOMERY, ALA.—Montgomery Light & Traction Company is planning for the erection of a new substation to be equipped with five high capacity rotary converters and auxiliary apparatus.

FERNWOOD, MISS.—McComb-Magnolia Light & Railway Company is erecting a power house and work on electric car line will be started shortly.

GREENWOOD, MISS.—Power house will be built by Yazoo & Mississippi Valley Railroad. A. H. Egan, general superintendent, Memphis, Tenn.

JONESVILLE, MISS.—Boyd & Alexander will establish a modern electric lighting plant to supply Jonesville with light and power.

DE RIDDER, LA.—Electric light plant, which burned at a loss of $15,000, will be rebuilt by T. S. Reed, of Beaumont, Tex., and others.

MUSKOGEE, OKLA.—Efforts toward placing electrical appliances on the lines of the Muskogee Gas & Electric Company during July resulted in the sale of 27 vacuum cleaners, 20 irons, 4 electric grills, 3 percolators and 71 fans.

DATES AHEAD.

Colorado Electric Light, Power and Railway Association. Annual convention, Colorado Springs, Colo., September 20-22. Secretary, T. F. Kennedy, 900 15th Street, Denver, Colo.

American Electrochemical Society. Annual convention. Pittsburgh, Pa., October 3 to 6. Secretary, Prof. J. W. Richards, Lehigh University, South Bethlehem, Pa.

National Electrical Contractors' Association of the United States. Annual convention, New Orleans, La., October 10 to 13. Secretary, H. C. Brown, Utica, N. Y.

TEMPLE, OKLA.—Franchise has been granted to John C. Keyes, of Lawton, to supply electricity and gas, transmitting power from Lawton.

WAUKOMIS, OKLA.—Municipal lighting plant here has been taken over by Central Oklahoma Light & Power Company of Enid and Oklahoma City. The new owner expects transmission line from Enid to be completed by Oct. 1.

HOWE, TEX.—Local exchanges of Grayson Telephone Company and Southwestern Telephone Company have been consolidated.

MARFA, TEX.—Marfa Electric Light & Ice Company's electric light plant has been acquired by Morrison & McCall, of St. Louis, who will install a large amount of additional machinery and increase plant's capacity.

RULE, TEX.—Plant of Haskell Telephone Company was destroyed by fire Aug. 27.

SAN ANTONIO, TEX.—San Antonio Public Service Company is contemplating construction of extension to Camp Travis. W. B. Tuttle, general manager.

WESTERN STATES.

ANACONDA, MONT.—Mountain State Telephone & Telegraph Company will spend $35,000 in improving telephone system.

BIG TIMBER, MONT.—Council has passed resolution for installation of new street-lighting system, which is subject to approval of taxpayers. System provides for 32 single post lights, 250 candlepower each, in business district and 41 single lights of same candlepower for resident districts, etc. Estimated cost, $5,300.

COLUMBUS, MONT.—Montana Power Company is laying out a new power site on the West Rosebud River at the foot of the falls. A site for a dam will be surveyed across the mouth of Mystic Lake and a survey will also be run for a tunnel that will tap the bottom of the lake a quarter of a mile from the foot of the falls.

HARLEM, MONT. — Fairbanks-Morse Company has been awarded contract for supplying major portion of equipment including engines, exciter sets, storage tanks, etc., for the light plant to be installed by this city at $9380. Electric Construction Company of St. Paul awarded contract for pole line and switchboard, including commercial and street lighting circuits.

KALISPELL, MONT.—Northern Idaho & Montana Power Company has secured renewal of its white way street lighting contract with Kalispell.

MALTA, MONT.—Council has passed ordinance creating three special improvement districts for installation of street lighting, to cost $45,000.

CHEYENNE, WYO. — Belle Fourche Northern Telephone lines will be taken over by Salisbury and Thompson, two business men, and $5000 will be spent in repairing and putting system in shape.

TEXICO, N. M.—State Line Utilities Company, recently incorporated with capital of $30,000, will build an electric light and power plant here, to supply this place and other towns in vicinity with electrical energy.

FLORENCE, ARIZ. — Representatives of Sidney Spitzer & Company, of Toledo, O., have agreed to take the $50,000 light bond issue at par.

THATCHER, ARIZ.—City will erect a building and install modern electric light plant.

TROY, IDA.—Franchise has been granted to W. B. McDonald to install a power and light plant, construction of same to begin soon.

EVERETT, WASH. — Council has bought a power site in Sultan Basin to be developed to furnish power for Everett.

EVERETT, WASH.—The city has secured 100 acres of land in the Horse Shoe Bend on the Sultan river as a site for a power plant.

GOLDENDALE, WASH.—Pacific Power & Light Company has made application to the county commissioners for a 50-year franchise to construct, reconstruct and operate transmission lines for power, light, etc.

SEATTLE, WASH. — Arrow Electric Company, 1627 Fourth avenue, has closed a contract with the Port of Seattle Commission for electrical installations in the grain elevators of the port, contract amounting to $2240.

SEATTLE, WASH.—Bids will be received by City Comptroller Harry W. Carroll up to Sept. 22 for $390,000 of lighting department utility bonds, interest not to exceed 6 per cent.

SEATTLE, WASH.—Board of Public Works is receiving sealed bids for construction of a trestle on Thorndyke avenue for the Municipal Railway.

SEATTLE, WASH.—Puget Sound Traction, Light & Power Company has plans for installation of equipment at its power plant on Western avenue and University street that will enable it to burn powdered coal, due to oil shortage. Equipment may cost $100,000 and will be housed in a one-story building, 44x120 feet, to cost $25,000. The company will also make extensive improvements at its Georgetown Station (Seattle) plant, installing automatic stokers, etc., to burn coal.

SKYKOMISH, WASH.—City is considering installing a municipal lighting and power plant, requiring bonds in the sum of $7,000.

VANCOUVER, WASH.—An electrical generating system is to be installed on the Columbia river interstate bridge, made necessary through lack of sufficient current to operate the lift span. The Interstate Bridge Commission authorized improvement, which will cost about $7000. General Electric Company secured contract for the equipment at $5200.

KAMLOOPS, B. C., CANADA.—Power house to be constructed at King Edward Sanitorium, Tranquille, and election plant will be enlarged; cost about $5,000.

NORTH VANCOUVER, B. C., CANADA.—City Council is considering question of buying power and light plant of British Columbia Electric Railway Company.

JOHN DAY, ORE.—Consolidated Electric Light Company has been leased to Johnson & Bocack for five years.

PORTLAND, ORE.—Grass Valley, Moro and Wasco, the three principal cities of Sherman County, have granted franchises to promoters said to be working in the interests of the Pacific Power & Light Company, for 24-hour electric light and power service, to be supplied from White River Falls. The lighting system and plants at each town have been bought by the new company and will be replaced by new machinery.

SUMPTER, ORE.—Sumpter Power & Water Company will rebuild its plant here.

JEROME, IDA.—Idaho Power Company is planning to construct an 80-mile power line from this place to Jarbidge, Nevada.

BLYTHE, CAL.—Council has granted Southern Sierras Power Company a 50-year franchise to operate here.

CRESCENT MILLS, CAL.—Great Western Power Company has completed high-power line from Las Plumas to Veramount Station on the line of the Indian Valley Railroad.

DE SABLA, CAL.—Pacific Gas & Electric Company will install lighting arresters at Coal Canyon and Lime Saddle power houses, and also rewire the transformer banks for "star" connection.

EL MODENO, CAL.—Taxpayers have signed and filed a petition with Board of Supervisors of Orange, asking for a lighting system for El Modeno.

FRESNO, CAL.—Edison Electric Company, of Los Angeles, is negotiating for purchase of Shaver Lake power site from Ira Bennett.

GLENDALE, CAL.—J. Dowling & Company, of San Francisco, have contract for erection of Sunset Telephone building to be erected here.

GLENDALE, CAL.—Pacific Telephone & Telegraph Company will erect new ex-

change building on Grand boulevard, near Broadway, to cost $45,137.

LOS ANGELES, CAL.—Council has passed ordinance providing for lighting of Sierra Bonita for one year.

LOS ANGELES, CAL.—Los Angeles County will erect a one-story brick power house at 1126 Mission Road.

OROVILLE, CAL.—Pacific & Electric Company will install a 3¼-inch centrifugal pump driven by a 15-horsepower motor at Bridge and Montgomery streets.

SAN DIEGO, CAL.—Council has adopted resolution authorizing the lighting of streets in certain sections of city.

SAN DIEGO, CAL.—San Diego Consolidated Gas & Electric Company has filed application to operate in Oceanside.

SAN FRANCISCO, CAL.—Coast Counties Gas & Electric Company has been granted permission to operate in Gilroy, Cal.

SAN FRANCISCO, CAL.—Public Utilities Committee has authorized city engineer to prepare plans for connecting Parkside district with Twin Peaks tunnel. It is estimated this line will cost $90,000.

SANTA MONICA, CAL.—Council has adopted ordinance for installing ornamental lighting system on Colorado avenue.

YREKA, CAL.—Hazel Mining Company will install electric power equipment in Gladstone mine at French Gulch.

INCORPORATIONS

BIRMINGHAM, ALA.—Alabama Storage Battery Company. Capital $6000. H. W. Matthews is president; Fred Sintes vice-president and C. R. Matthews secretary and treasurer.

LOS ANGELES, CAL. — Olive Street Electrical Company. Capital $10,000. Incorporators: A. H. and S. Thompson and F. Bingham.

BOISE, IDA.—Western Ignition & Battery Company. Capital $15,000. S. A. Oakley, W. Arland Oakley and W. S. Oakley.

NEW YORK, N. Y.—Delisser Engineering Corporation. Capital $10,000. To conduct a general electrical engineering business. Incorporators: M. and A. Delisser and J. C. L. Rogge, 50 Broad street.

SYRACUSE, N. Y.—H. J. Gorke, Inc. Capital $50,000. To manufacture electrical specialties. Incorporators: Karl S., Herman J. and D. Gorke, all of Syracuse.

SYRACUSE, N. Y.—Iroquois Public Service Corporation has incorporated to operate a telephone and telegraph service, mainly in Masonville, Delaware county. Capital $1,500,000. Directors: L. S. Chapman, A. S. Ellis, M. G. Grossman, R. Love, B. H. Shepard, L. N. Vines, N. P. Bonney, T. H. Ferris, L. H. Jenks and H. L. Paddock.

GRASSY BUTTE, N. D.—Klideer-Grassy Butte Telephone Company. Capital $5,000. Incorporators: Robert Wilcox and E. P. Merrill. About 25 miles of line will be built at a cost of $1,500 to $3,000.

THORNE, N. D.—Thorne Telephone Company. Capital $25,000. The company will build 28 miles of line at estimated cost of $2,760.

LUCASVILLE, O.—Lucasville Light & Power Company. Capital $2,500. Incorporators: Austin Taylor, Joseph H. Appel, Cleve Bricker, P. J. Lockhart, Frank Brant, A. S. Moulton and A. E. Purdy.

STROUDSBURG, PA. — Stroudsburg Traction Company. Capital $200,000. To maintain and operate a local traction system. Harry E. Sweeney, treasurer.

ANTREVILLE, S. C.—Antreville Telephone Company. Capital $1,000. Incorporators: B. A. Keston and Frank A. Carwell.

FAIRY, TEX.—Fairy Telephone Company. Capital $30,000. Incorporators: Ernest R. Eudaley and Benn Gleason.

GRAFTON, W. VA. — Cecil Telephone Company. Capital $5,000. Incorporators: E. T. Colebank, J. H. Alexander and W. S. Rogers.

PROPOSALS

DISTRIBUTION TRANSFORMERS.—Board of Public Works, Seattle, Wash., will receive bids until 10 a. m., Oct. 5, for about 450 distribution transformers for city lighting department during coming year. Satisfactory surety bond or certified check for $2000 payable to order of city comptroller required.

ELECTRICAL MATERIAL.—Bureau of Supplies and Accounts, Navy Department, Washington, D. C., is inviting bids on the following material: Ammeters, switchboard type; fuse blocks, cartridge type, etc.; bronzed finish brackets; 10,000 hard rubber insulating bushings; 100 Bosch spark coil buttons; 550 rubber ear cushions and a miscellaneous number of igniters, magnetos, etc., fittings, for delivery at navy yard, Boston, Mass., schedule No. 1474.

ELECTRICAL EQUIPMENT.—Bids will be received by the Board of Public Works, Room 234, County-City Building, Seattle, Wash., up to Sept. 28 for furnishing eight air brakes, including safety control and electrical equipment for single track double end safety motor passenger cars for Division A of the Seattle municipal street railway.

ELECTRICAL EQUIPMENT. — Superintendent of Prisons, Lighting, Telephone and Clock, Department of Justice, Washington, D. C., will receive bids until Sept. 28 for furnishing and delivering at United States Penitentiary, Leavenworth, Kans., material for electric light, telephone and clock installations for the west main cell wing, in accordance with specifications, obtainable from Superintendent.

Electrical Patents Issued August 28, 1917

Prepared by Thomas Howe, Patent Attorney, 2 Rector Street, New York, N. Y.

1,238,076. Impulse-transmitting Device. A. H. Adams, assignor to Western Electric Co., New York, N. Y. Calling device for telephone system.

1,238,082. System for Controlling Electrically-driven Machines. F. Balzer, Chicago, Ill., assignor to Troy Laundry Machinery Co. For controlling motors driving washing machines.

1,238,106. Automatic Switch. H. P. Clausen, assignor to Western Electric Co. For telephone systems.

1,238,107. Impulse Sending Device. H. P. Clausen, assignor to Western Electric Co. Calling device for telephone systems.

1,238,124. Electric Heating Unit. R. E. Frickey, Redding, Cal. Tubular structure adapted for attachment to end of lamp cord.

1,238,129. Automatic Telephone-Exchange System. C. L. Goodrum, assignor to Western Electric Co. Arrangement of stepping magnets and grouping of lines.

1,238,130. Machine-switching Telephone Exchange System. C. L. Goodrum, assignor to Western Electric Co. For serving a combination of restricted and non-restricted lines.

1,238,131. Calling Device. C. L. Goodrum, assignor to Western Electric Co. Impulse transmitter for telephone systems.

1,238,134. Combination-Lock for Automobile Ignition-Switches. L. M. Greif, Cleveland, Ohio. Details of ratchet and plunger arrangement.

1,238,140. Automatic Telephone System. O. E. Hill, assignor to Western Electric Co. Arrangement and structure of automatic switch.

1,238,141. Telephone-Exchange System. E. E. Hinrichsen and L. H. Johnson, assignors to Western Electric Co. Special trunk circuit.

1,238,145. Electrical Regulating Device. G. Honold and H. Conzelmann, assignors to firm of R. Bosch, Stuttgart, Germany. Resistance field control of dynamo for automobile lighting.

1,238,148. Trolley Mechanism for Railway Cars. C. Kaspar, Chicago, Ill. For lowering and securing pantograph from platform.

1,238,153. Loading Unit for Telephone Systems. G. A. Kelsall, assignor to Western Electric Co. For physical and phantom circuits.

1,238,155. Dimming-Switch for Projection-Lamps. K. Kleinert, assignor to firm of R. Bosch. Key-operated structure mounted on headlight.

1,238,160. Telephone System. A. E. Lundell, assignor to Western Electric Co. Automatic.

1,238,161. Controlling System. A. E. Lundell, assignor to Western Electric Co. Key controlled, multiple position switch.

1,238,162. Electric Switch. F. A. Lundquist, assignor to Western Electric Co. For telephone systems.

1,238,163 and 1,238,164. Automatic Switch. F. A. Lundquist, assignor to Western Electric Co. For telephone systems.

1,238,193. Machine-switching Telephone-Exchange System. J. N. Reynolds, assignor to Western Electric Co. For connecting incoming lines with trunks.

1,238,194. Automatic Switch. J. N. Reynolds, assignor to Western Electric Co. Connecting switch for telephone system.

1,238,206. Welding Apparatus. E. A. Shuler, assignor to Pullman Co., Chicago, Ill. Portable apparatus for welding nails to a metal sheet.

1,238,213. Electric Generator and Motor. H. R. Stuart, assignor to Robbins & Myers Co., Springfield, Ohio. Structure and winding of field magnets of direct current machine.

1,238,243. Field-Coil Support. J. O. McK. Yardley, assignor to Westinghouse Electric & Mfg. Co., E. Pittsburgh, Pa. For interpolar machines.

1,238,250. Electrical Appliance. C. H. Bissell and D. C. Gidley, assignors to Crouse-Hinds Co., Syracuse, N. Y. Structure of attachment socket.

1,238,251. Electrical Protective Device. H. W. Brown, assignor to Westinghouse Electric & Mfg. Co. A relay modified by power factor device so that its action depends upon watts.

1,238,261. Switch. J. F. Cavanagh, assignor to Connecticut Telephone & Electric Co., Meriden, Conn. Device has contacts controlled by push and rotation.

1,238,265. Telephone-Exchange System. H. P. Clausen, assignor to Western Electric Co. Manner of operating selector switch by impulses.

1,238,277. Arc-Lamp. J. L. Dinsmoor, assignor to Westinghouse Electric & Mfg. Co. Arc is stabilized by a helical magnetic sleeve about an adjacent conductor.

1,238,280. Coil-Support. A. B. Field, assignor to Westinghouse Electric & Mfg. Co. End twin support for dynamo electric machines.

1,238,287. Electrical Plug-Connector. W. S. Hadaway, Jr., E. N. Lightfoot and J. Amon, assignors to Cutler-Hammer Mfg. Co., Milwaukee, Wis. Structure of device having a number of sockets.

1,238,288. Automatic Organ and the Like. C. E. Holdeman, Alhambra, Cal. Electrically operated.

1,238,290. Universal Motor. A. McR. Harrelson, assignor to Emerson Electric Mfg. Co., St. Louis, Mo. For operation on both direct and alternating currents.

1,238,292. Ventilating Construction for Dynamo-Electric Machines. R. E. Hellmund, assignor to Westinghouse Electric & Mfg. Co. Arrangement of air passages and fan for circulation through enclosed machine.

1,238,304. Dynamo-Electric Machine. J. A. Kuyser, assignor to Westinghouse Electric & Mfg. Co. Structure of end-turn supports.

1,238,311. Contact. A. L. Loguin, assignor to Allis-Chalmers Co., Milwaukee, Wis. Structure of controller finger.

1,238,313. Polyphase-Electromagnet Brake Control. B. McInnerney, assignor to Westinghouse Electric & Mfg. Co. Structure of pole pieces and armature to give constant pull on latter.

1,238,321. Rotor-winding for Asynchronous Machines. S. G. Nottage, assignor to Westinghouse Electric & Mfg. Co. Arrangement of two short-circuited windings.

1,238,323. Signal Mechanism. P. E. Oswald, assignor to J. M. Carson, Los Angeles, Cal. Structure of device having electromagnetically-operated target.

1,238,336. Switching Apparatus. C. Renshaw, assignor to Westinghouse Electric & Mfg. Co. Mounting of a switch group.

1,238,337. Motor-control System. L. G. Riley, assignor to Westinghouse Electric & Mfg. Co. Special inter-related brake and motor control for electrically-propelled vehicle.

1,238,339. Art of Producing and Treating Hydrocarbon Vapors During the Distillation of the Same. J. H. Robertson, assignor to Robertson Motor Fuel Process Corp., New York, N. Y. A disruptive current is passed through the heated vapors of crude oil during their distillation.

1,238,345. Magnetic Latch Device. F. A. Schoenle, Buffalo, N. Y. Electromagnetically-operated oscillating door latch.

1,238,348. Signaling Device for Vehicles. F. S. Seymour, Holyoke, Mass. Structure of electric motor operated audible and visual direction indicator.

1,238,350. Telephone System. F. M. Slough, assignor to Stromberg Carlson Telephone Mfg. Co., Rochester, N. Y. Arrangement of manually-operated link circuit.

1,238,363. Burglar-Alarm System. R. W. Vail, New York, N. Y. Alarm circuit is controlled by endless, motor-driven traveling element extending across protected structure.

1,238,365. Automatic Electric Fan. J. W. Warriner, Sioux Falls, S. D. A single motor operates several independently controllable fans.

1,238,382. Electric Switch. G. Biddle, Oakland, Cal. Single push button wall switch.

1,238,401. Pull Attachment for Key Sockets. P. Golatzky, assignor to H. Krich, Newark, N. J. Structural details.

1,238,406. Arc-Welder. A. H. Homrighaus, assignor to Lincoln Electric Co., Cleveland, Ohio. Generator has a separately excited winding and an opposed series winding with means for adjusting the latter whereby there may be adjustments for stable ranges of automatic regulation from a given no-load voltage.

1,238,419. Tail-Lamp for Motor Vehicles. E. W. McKinley and E. J. Grigsby, Akron, Ohio. Details of structure having interior lighted, rotatable signal drum.

1,238,430. Automobile-Signal. G. H. Nierman, Cleveland, Ohio. Electromagnetically operated direction indicator.

1,238,439. Telephone for Transmitting and Reproducing Sounds. R. Rummler, Wilmette, Ill. Arrangement of magnet, coil and vibrating member.

1,238,443. Rectifier. H. K. Sandell, assignor to H. S. Mills, Chicago, Ill. Commutator apparatus.

1,238,446. Lens for Headlights. T. T. Seal, Bellaire, O. Structure of device having translucent central portion.

1,238,448. Device for Avoiding the Twisting of Electric Wires. J. D. Shaw, Buenos Aires, Argentina. Structure of swiveling plug connection.

1,238,455. Magnetic Speedometer. J. K. Stewart, deceased, by J. B. Stewart, said J. K. Stewart assignor to Stewart-Warner Speedometer Corp., Chicago, Ill. Details of construction.

1,238,459 and 1,238,460. Attachment-Plug. W. C. Tregoning, assignor to Benjamin Electric Mfg. Co., Chicago, Ill. Structural details.

1,238,462. Rail-Bond. T. M. Utley, Superior, Wyo. Manner of securing bond to rail.

1,238,466. Electric Hoist. A. S. Watson, assignor to Detroit Hoist & Machine Co., Detroit, Mich. Clutching mechanism between driving and driven member.

1,238,468. Method for Determining Heat Ratios. I. H. Wilsey, assignor one-half to F. A. Adkins, Chicago, Ill. Manner of combining electric circuits affected by the respective heats to be measured.

1,238,477. Switch Containing Electric Lamp Socket. E. G. K. Anderson, assignor to Benjamin Electric Mfg. Co. Structure of switch mounted in lamp socket.

1,238,481. Gas Engine Speed Controller. R. B. Benjamin, assignor to Benjamin Electric Mfg. Co. Supply of fuel and ignition are automatically, electromagnetically controlled to maintain constant speed.

1,238,482. Thief-proof Lamp-holding Device. R. B. Benjamin, assignor to Benjamin Electric Mfg. Co. Key-controlled socket for preventing unauthorized removal of lamp.

1,238,483 and 1,238,484. Reflector. R. B. Benjamin, assignor to Benjamin Electric Mfg. Co. For headlights.

1,238,485. Shade-holding Device. R. B. Benjamin, assignor to Benjamin Electric Mfg. Co. For socket attachment.

1,238,512. Automatic Train-Stop. J. Gut, Cleveland, Ohio. Trip-operated electrical means control steam and brakes.

1,238,516. Motor-Controller. C. T. Henderson and H. J. Harries, assignors to Cutler-Hammer Mfg. Co., Milwaukee, Wis. Manner of controlling shunt field.

1,238,529. Battery. N. Kribs, Dundee, Ill. Manner of mounting and connecting superposed dry cells.

1,238,532. Portable Burglar-Alarm. L. Lemberg, Brooklyn, N. Y. Circuit-closing apparatus for alarm circuit.

1,238,533. Apparatus for Generating High-tension Electrical Impulses and Ignition Systems. L. J. LePontois, assignor to Teagle Co., Cleveland, O. Structure of magnets.

1,238,534. Method for Generating High-tension Sparks for Ignition Purposes. L. J. LePontois, assignor to Teagle Co. Method of utilizing the flux of a permanent magnet to produce the sparks.

1,238,540. Three-way Pull-Chain Socket. J. F. McCarthy, New York, N. Y. Structural details.

1,238,549. Electric-Light Fixture. G. Marx, Pawnee, Okla. Details of construction.

1,238,565. Speed-changing, Reversing and Braking Gearing. G. Pollard, assignor to Menco-Elma Syndicate, Limited, London, Eng. Electromagnetically controlled.

1,238,566. Sound-Producer. F. J. Porter, Columbus, Ohio. Connection of sound producers with operating shafts is electromagnetically controlled.

1,238,573. Electrical System. N. F. Rutherford, East Falmouth, Mass. Manner of grouping the elements.

1,238,574. Condenser or Cooler. A. E. L. Scanes, assignor to British Westinghouse Electric & Mfg. Co., Ltd., London, Eng. Of the surface type; has a metal plate for counteracting electrolytic action in the condenser.

1,238,575. Method of Producing Filament-Supports for Incandescent Lamps. O. Schluter, assignor to General Electric Co., Schenectady, N. Y. Method of fixing radially projecting wires in the end of a glass rod or hub.

1,238,582. Lamp-Guard Clamp. J. F. Shields, Garfield, Utah. Structural details.

1,238,590. Cover for Dynamo-Electric Machines. C. W. Starker, assignor to Westinghouse Electric & Mfg. Co. End bracket is covered with a screen of expanded metal.

1,238,597. Electric Switch. J. M. Terzich, Amador City, Cal. Details of structure having pivoted arm.

1,238,600. Process of Producing Alkalis from Kelp. H. L. Trumbull, Seattle, Wash. Kelp is electrolyzed under specified conditions.

1,238,608. Valve Actuating Mechanism. J. A. Whitton, Los Angeles, Cal. Valves are operated by electromagnets.

1,238,638. Direction Indicator. M. Colby, Springdale, Wis. Electromagnetically operated; for automobiles.

1,238,640. Electric-Lamp Shade Holder. G. M. Condit, assignor to American Ring Co., Waterbury, Conn. Carried by arms engaging the socket and bulb.

1,238,643. Electric Car-Brake. J. Davidon, New York, N. Y. Structure of electromechanical device.

1,238,660. Electric Discharge Apparatus. C. Field-Frank, assignor to General Electric Co. Has two electrodes with dry, powdered lead peroxid between them to receive discharges between them.

1,238,666. Electric Motor or Generator. E. A. Halbleib, assignor to North East Electric Co., Rochester, N. Y. Manner of mounting and protecting brushes and controlling devices at commutator.

1,238,667. Electric-Circuit Controller. E. A. Halbleib and T. L. Lee, assignors to North East Electric Co., Rochester, N. Y. Electromagnetically operated switch.

1,238,671. Electrically-heated Soldering Tool. L. Holcomb, Las Vegas, Nev. Of the fountain type.

1,238,684. Electrical-Lamp Lock. W. C. Kerch, Mill Valley, Cal., assignor one-half to C. Rothschild and one-half to S. Dusenberry, San Francisco, Cal. Prevents unscrewing of lamp from socket.

1,238,690. Fuse-Plug. E. D. Knott, New Orleans, La. Structure of device having attachment plug at one end, socket at other and fuse between them.

1,238,701. Gear-shifting Apparatus. N. W. Saunders, assignor to S. M. C. Co., Inc., Detroit, Mich. Electromagnetically operated.

Patents Expired.

The following United States electrical patents expired on September 11, 1917:

657,510. Perforator Keyboard. C. L. Buckingham and E. Germann, New York, N. Y.

657,516. Motor Vehicle. C. J. Coleman, Chicago, Ill.

657,541. Device for Fixing Incandescent Electric Lamps. L. J. P. Hollub and H. Mignal, Paris, France.

657,574. High-voltage Insulator. A. Sinding-Larsen, Frederiksvaern, Norway.

657,623. Ice-removing Trolley for Electric Railways. J. J. Shirkey, Chicago, Ill.

657,637. Trolley Head. S. Bourgeois, Manchester, N. H.

657,638. Secondary-battery Plate. W. Bowker, Sr., Waltham, Mass.

657,646. Apparatus for Reclaiming Tin and Zinc from Tinned and Zinc Scrap. G. B. and P. Cruickshank, Birmingham, England, and H. R. S. Coleman, Smethwick, England.

657,659. Secondary Battery. A. Jamieson, Elizabeth, N. J.

657,662. Controlling Means for Explosive Engines. F. A. LaRoche, New York, N. Y.

657,672. Protective Device Against Burglary. A. Petternel, Siebenhirten, Austria-Hungary.

657,678. Secondary Electric Clock. G. P. Rose, Jr., Dubuque, Iowa.

657,694. Electric Clock. G. Fichter, Lynn, Mass.

657,703. Electrical Rheostat. H. W. Leonard, New York, N. Y.

657,722. Means for Controlling Exictation of Boosters or Generator Fields. J. Appleton, Philadelphia, Pa.

657,730. Electric-railway Signal. G. H. Dunham, Quincy, Mass.

657,732. Coupling for Electric Conduits. E. S. Francis, Hartford, Conn.

657,736. Electric Furnace. W. S. Horry, Sault Ste. Marie, Mich.

657,757. Electric Bond for Railway Rails. H. P. Brown, Montclair, N. J.

657,760. Electric Igniter for Explosive Engines. I. H. Davis, Boston, Mass.

657,782. Electric Elevator. J. W. Mabbs, Chicago, Ill.

657,795. Electric Circuit-closer for Looms. H. W. Smith and W. H. Redding, Worcester, Mass.

657,804. Tip for Commutator Segments. A. R. Westerdahl, New York, N. Y.

657,824. Conveying Apparatus. R. T. Jenney, London, England.

657,828. System of Multiple-rate Metering. E. Oxley, Lynn, Mass.

657,829. Multirate Meter. E. Oxley, Lynn, Mass.

657,830. Conductor and Collector for Electric Railways. A. Ptezenburger, Berlin, Germany.

657,853. Electric Lock. H. G. Carleton, New York, N. Y.

657,854. Combined Telephone Signal and Jack. O. R. Cline, Eldorado, Kans.

657,861. Electric Measuring and Indicating Apparatus. H. Darwin, E. H. Griffiths and W. C. D. Whetman, Cambridge, England.

657,857. Electric Train-signal Device. J. F. Scullen, Chicago, Ill.

657,892. Electrically Actuated Safety Device for Elevators. N. B. Keyser, Philadelphia, Pa.

657,899. Motor Vehicle. C. J. Coleman, Chicago, Ill.

Financial News and Comment

Officials of the Puget Sound Traction, Light & Power Company, at the hearing before the Public Service Commission of Washington for authority to discontinue sale of 4-cent tickets, submitted data showing that the company was operating at a deficit of .55 cent for each car-mile, which would be lowered to .26 cent a car-mile with the elimination of the 4-cent ticket. A deficit of 1.22 per cent in net earnings was reported for 1915 and .85 per cent for 1916. Although passenger earnings for the first six months of 1917 were shown to be $1,680,677, an increase of 14 per cent over the six months of 1916, costs of materials were shown to have made increases of from 12 to 633 per cent. The commission has taken the case under advisement.

Idaho Power Company, a subsidiary of National Securities Corporation, has sold $700,000 two-year 6 per cent secured gold notes dated September 1, 1917, to Harris, Forbes & Company, and Coffin & Burr, Inc., who are offering them at 98⅛ per cent to yield 7 per cent. The total amount of notes authorized is $3,000,000. The notes are secured by deposit of first mortgage bonds in ratio of $1,000 bonds to $700 notes.

Union Electric Light & Power Company, St. Louis, a subsidiary of North American Company, has filed application with the Missouri Public Service Commission for authority to issue $1,000,000 stock bearing 7 per cent interest, proceeds to be applied to reimbursing company's treasury for money expended on improvements.

The Ohio State Utilities Commission in modifying an order issued November 28, 1916, authorizes the Central Power Company, of Canton, O., a subsidiary of American Gas & Electric Company, and which absorbed the Sunnyside Electric Company and the Ohio Light & Power Company, to issue and sell refunding mortgage bonds of $7,999,000, of which $5,063,000 is to be sold for not less than 85. The proceeds of the sale are to be used in paying debt of three companies as follows: Central Power Company, $228,000; Sunnyside Electric Company, $2,045,362, and the Ohio Light & Power Company, $1,969,828. The Central Power Company has now outstanding about $1,400,000 bonds.

Republic Railway & Light Company subsidiaries have filed a new schedule applicable to power customers, carrying an increase of practically 20 per cent over prior existing schedules. This new schedule is based on the present cost of coal and is an addition to the previous increases already granted. The new rates cover both the Ohio and Pennsylvania territory of the Republic Railway & Light Company and will apply upon the power business beginning with September.

The Allis-Chalmers Manufacturing Company declared an extra dividend of ¾ of 1 per cent on the preferred stock on account of accumulation. The usual quarterly dividend of 1¾ per cent also has been declared on the issue. Three months ago ¾ of 1 per cent was paid on account of accumulation. The dividends are payable October 15 to stock of record September 29.

Reports of Earnings.

ARKANSAS LIGHT & POWER COMPANY.

	1917.	1916.
July gross	$ 37,048	$ 33,642
Net after taxes	14,058	14,069
Twelve months' gross.	359,822	317,041
Net after taxes	134,413	143,688
Surplus after charges.	66,648	76,068

TWIN CITY RAPID TRANSIT COMPANY.

	1917.	1916.
July gross	$ 858,177	$ 880,859
Net after taxes	290,571	360,703
Surplus after charges.	139,899	215,657
Seven months' gross..	6,034,122	5,890,275
Net after taxes	2,058,444	2,227,495
Surplus after charges.	1,031,761	1,229,062

CENTRAL STATES ELECTRIC CORP.

Cleveland Electric Illuminating Co., a subsidiary of Central States Electric Co., reports earnings as follows:

	1917.	1916.
July gross	$ 490,919	$ 356,723
Net after taxes	165,877	158,481
Surplus after charges	75,687	83,646
Seven months gross.	3,752,763	2,887,421
Net after taxes	1,061,739	1,394,579
Surplus after charges	367,263	847,147

Copper Market.

Copper quotations for August averaged 25.38 cents per pound, which was the lowest average since July, 1916, when they averaged 23.86 cents. The course of prices for the last three years is shown in the following table of monthly averages, the figures representing cents per pound:

	1917.	1916.	1915.
January	28.673	24.008	13.641
February	31.750	26.440	14.394
March	31.481	26.310	14.787
April	27.935	27.895	16.811
May	28.788	28.625	18.506
June	29.962	26.601	19.477
July	26.620	23.865	17.796
August	25.380	26.120	16.941

Exports of copper from the United States since January, 1915, are given in the following table, and the strong European demand shown for the first six months of 1917 will be noted. The figures given represent tons of 2,240 pounds:

	1917.	1916.	1915.
January	51,322	23,663	26,193
February	32,265	20,648	15,583
March	51,218	26,321	30,148
April	49,536	21,654	18,738
May	49,245	16,062	28,889
June	39,816	39,595	16,976
July	21,610	35,006	17,708
August	.....	32,160	17,551
September	.....	29,403	14,327
October	.....	33,224	24,087
November	.....	22,598	23,168
December	.....	26,486	42,426
Total	295,012	327,310	276,344

August production of copper is computed at 175,000,000 pounds, approximately, which is 25,000,000 pounds less than that of July, and 45,000,000 less than the June output. This diminution is due mostly to shutdowns and curtailments caused by labor strikes; and strike conditions still prevail in Montana, where the Anaconda mines, smelter and refinery are closed. Tension at Butte is further heightened by a referendum vote of the unions. A failure to adjust differences there is likely to result in Government control of those properties.

In the face of heavy demands, both domestic and foreign, and a decreased production, the prices of copper are focusing close around 25 cents. That is, late advices indicate that this is close to the figure at which the Government War Industries Board will pay for that metal.

In the last few days market conditions have been active. Quotations based on sales for prompt delivery are as follows: Lake copper, 27 to 28 cents; electrolytic, 26 to 26.50 cents.

WEEKLY COMPARISONS OF CLOSING-BID PRICES OF SECURITIES OF LEADING ELECTRICAL COMPANIES.

Quotations furnished by F. M. Zeiler & Co., Rookery Bldg., Chicago.

Public Utilities—	Div. rate Per cent.	Bid Sept. 4.	Bid Sept. 11.
Adirondack Electric Power of Glens Falls, common	..	16	16
Adirondack Electric Power of Glens Falls, preferred	6	68	68
American Gas & Electric of New York, common	10+extra	114	112
American Gas & Electric of New York, preferred	6	46	46
American Light & Traction of New York, common	..	275	277
American Light & Traction of New York, preferred	6	105	105
American Power & Light of New York, common	4	60	60
American Power & Light of New York, preferred	6	80	82½
American Public Utilities of Grand Rapids, common	..	27	28
American Public Utilities of Grand Rapids, preferred	6	62	63
American Telephone & Telegraph of New York	..	..	114½
American Water Works & Elec. of New York, common	..	6	6¼
American Water Works & Elec. of New York, particip	7	19	17
American Water Works & Elec. of New York, first preferred	..	68	65
Appalachian Power of Bluefield, common	..	4	2½
Appalachian Power of Bluefield, preferred	7	27	24
Cities Service of New York, common	6+extra	250	243
Cities Service of New York, preferred	6	83	83¾
Commonwealth Edison of Chicago	8	..	116½
Comm. Power, Railway & Light of Jackson, common	4	47	47
Comm. Power, Railway & Light of Jackson, preferred	6	75	75
Federal Light & Traction of New York, common	..	..	10
Federal Light & Traction of New York, preferred	..	..	45
Illinois Northern Utilities of Dixon	6	..	77
Middle West Utilities of Chicago, common	2+2 extra	..	37½
Middle West Utilities of Chicago, preferred	6	..	68
Northern States Power of Chicago, common	7	86	82
Northern States Power of Chicago, preferred	7	96	96½
Pacific Gas & Electric of San Francisco, common	5	53	51½
Pacific Gas & Electric of San Francisco, preferred	6	87¼	87
Public Service of Northern Illinois, Chicago, common	7	..	85½
Public Service of Northern Illinois, Chicago, preferred	6	..	96
Republic Railway & Light of Youngstown, common	4	33	31
Republic Railway & Light of Youngstown, preferred	6	64	63
Standard Gas & Electric of Chicago, common	..	8	8
Standard Gas & Electric of Chicago, preferred	6	34	33
Tennessee Railway, Light & Power of Chattanooga, common	..	5	4
Tennessee Railway, Light & Power of Chattanooga, preferred	6	27	25
United Light & Railways of Grand Rapids, common	4	38	36½
United Light & Railways of Grand Rapids, preferred	6	70	68
Western Power of San Francisco, common	..	13	12½
Western Power of San Francisco, preferred	6	54½	54
Western Union Telegraph of New York	extra	89⅞	89½
Industrials—			
Electric Storage of Philadelphia, common	4	58	57
General Electric of Schenectady	8	145⅜	138½
National Carbon of Cleveland, common	8	78	*78
National Carbon of Cleveland, preferred	..	130¾	*130¾
Westinghouse Electric & Mfg. of Pittsburgh, common	5+extra	43¾	44¾
Westinghouse Electric & Mfg. of Pittsburgh, preferred	7	..	60

*Last sale.